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**Projecting the Regional
Demo-Economic Impacts of Natural
Resource Mega-Projects:
A Comparison of Two Techniques**

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ABSTRACT

Natural resource mega-projects are expected to generate substantial regional employment and population growth. A demo-economic analysis is the component of a comprehensive environmental impact assessment that addresses these regional growth impacts. The results of the demo-economic analysis are used in several other aspects of project planning, such as community land use planning. Consequently, inaccuracies in the demo-economic analysis may have costly repercussions.

This research compared the accuracy of two techniques commonly employed in demo-economic impact analysis. The two techniques examined were economic base analysis (EBA) and income expenditure analysis (IEA).

Using the example of British Columbia's North East Coal Project (NECP), pre-project analyses were prepared based on information available when this mega-project was under construction. The pre-project projections were compared to an *ex post* analysis of the NECP's impacts on regional employment and population.

Contrary to expectations, the pre-project analyses produced similar demo-economic impact projections. Several improvements in EBA that were employed in the pre-project analysis, specifically inclusion of indirect employment in the multiplicand and correction of the employment multiplier for transfer payments, were responsible for this similarity. Without these technical innovations in EBA, IEA should be used in demo-economic impact analysis.

The pre-project and *ex post* analyses were also remarkably similar. Pre-project projections of employment and population impacts were 6% and 9% higher, respectively, than the actual impacts indicated by the *ex post* analysis. While all parameters in the *ex post* analysis varied from those assumed in the pre-project analysis, the multiplicand and the regional recruitment rates are the most important parameters in the mega-project case.

The research results suggest that analysts should construct several scenarios when completing pre-project impact projections and rigorously estimate the parameters under each scenario. The extensive appendix to this report provides a detailed discussion of parameter estimation procedures and data sources for EBA and IEA.

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TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	OVERVIEW OF DEMO-ECONOMIC IMPACT ANALYSIS	2
2.1	Overview	2
2.2	Special Considerations Associated with the Mega-project Context	7
3.0	THE CASE STUDY	10
4.0	STUDY APPROACH	10
5.0	RESEARCH RESULTS	12
5.1	The Parameter Estimates for the Pre-Project Analysis	12
5.2	Pre-Project Projections	20
5.3	<i>Ex Post</i> Analysis	21
6.0	DISCUSSION AND CONCLUSIONS	23
7.0	LITERATURE CITED	29
Appendix A	Regional Economic Impact Analysis Using Employment and Income Multipliers: Theoretical Basis and Empirical Estimation	35

LIST OF TABLES

1.	Selected Employment Multipliers: Published Estimates, 1980	16
2.	Selected Income Multipliers: Published Estimates, 1980	17
3.	Employment Multiplier Estimates: South Peace Region, 1981	18
4.	Income Multiplier Estimates: South Peace Region, 1981	18
5.	Comparison of Pre-Project Projections of the NECP's Regional Demo-Economic Impacts: South Peace Region, 1986	21
6.	Regional Population and Employment Impacts of the NECP: Projections and <i>Ex Post</i> Analysis, 1986	23

LIST OF FIGURES

1.	Flow Chart of Demo-Economic Impact Analysis	4
2.	South Peace Study Area	9



PROJECTING THE REGIONAL DEMO-ECONOMIC IMPACTS OF NATURAL RESOURCE MEGA-PROJECTS: A COMPARISON OF TWO TECHNIQUES

1.0 INTRODUCTION

Natural resource mega-projects are expected to stimulate high levels of regional economic growth. They are expected to provide employment opportunities for regional residents, to attract new residents to the region, to stimulate existing and new businesses, and to provide numerous additional economic benefits.

A demo-economic analysis is the component of a comprehensive environmental impact assessment (EIA) that addresses a project's impact on regional economic growth. These impact projections are used in other components of the EIA, in many aspects of project planning, and in the overall project evaluation.[1] Consequently, inaccuracies in the demo-economic analysis can have costly and wide-ranging repercussions.

There are a number of guides to preparing demographic and economic impact analyses, either separately or linked in a demo-economic model (Leistritz and Murdock 1981; Davis 1990; Schwartz 1983; Gunton n.d.; Isserman 1977a; Cantor et al. 1985). In addition, numerous academic articles explore modifications and improvements in various techniques (Davis 1986; Davis and Webster 1981; Gibson and Worden 1981; Kissling et al. 1984; Shahidsaless et al. 1983; Davis 1980; Smith et al. 1981; Isserman 1980; Simmons 1981; Isserman 1984; Ledent 1978; Pittenger 1977; van Dijk and Oosterhaven 1986). However, few of these publications report on the relative accuracy of different techniques based on empirical evidence.

This study assesses the relative accuracy of economic base analysis (EBA) and income expenditure analysis (IEA) in projecting the demo-economic impacts of a natural resource mega-project. The research results address the lack of empirically-based assessments of these

1. For example, the projected population impacts are used to assess community planning requirements.

techniques. In addition, a number of simple and effective improvements to the techniques are suggested.

EBA and IEA are best suited to analysis of the impacts of marginal changes in regional economic activity. The context of this research - a mega-project - is outside the range where these techniques could be expected to yield their most accurate results. Consequently, this research is expected to identify key parameters and issues to be considered when using these techniques in the mega-project context.

The next section presents an overview of demo-economic analysis and identifies the issues arising from the mega-project context.[2] After a brief description of the case study, the study approach is outlined and the research results presented, including a detailed discussion of the parameter estimates used in this research. Finally, the two techniques are compared in terms of data availability, ease of use, and relative accuracy in the case examined.

2.0 OVERVIEW OF DEMO-ECONOMIC IMPACT ANALYSIS

2.1 Overview

A demo-economic impact analysis consists of five basic steps (Figure 1). In the first three steps, the mega-project's regional economic impact is analyzed; in the last two, the population effect of the economic impact is estimated. It is in the economic portion that IEA and EBA are utilized; the procedures and assumptions applied in the last two steps are independent of the technique used to estimate the regional economic impacts.

The first step in completing a pre-project regional demo-economic impact analysis is to estimate the multiplicand, defined as the amount of regional economic activity generated by the project's expenditures on labour and other inputs. In EBA the multiplicand is defined as

2. A detailed discussion of the theoretical basis of the two techniques compared in this research, practical problems that must be overcome in utilizing them, and parameter estimation procedures and data sources is contained in the Appendix to the report.

the change in basic sector employment, which includes direct employment in the export industries and indirect employment in industries that supply goods and services to the export industries. In IEA the multiplicand is the regional income injection, or the amount of regional value-added, associated with the project's expenditures. Like the employment multiplicand, the income injection has a direct and indirect component.[3]

The multiplicand's direct component may be estimated from information provided by the project proponent who estimates the project's labour requirements in the construction and operating phases. These job estimates can be used as the estimate of direct employment in EBA. However, to use these estimates in IEA, they must first be converted to an income figure by multiplying the total employment by an average wage estimate. The average wage estimate may be obtained from the proponent, or from secondary sources.[4]

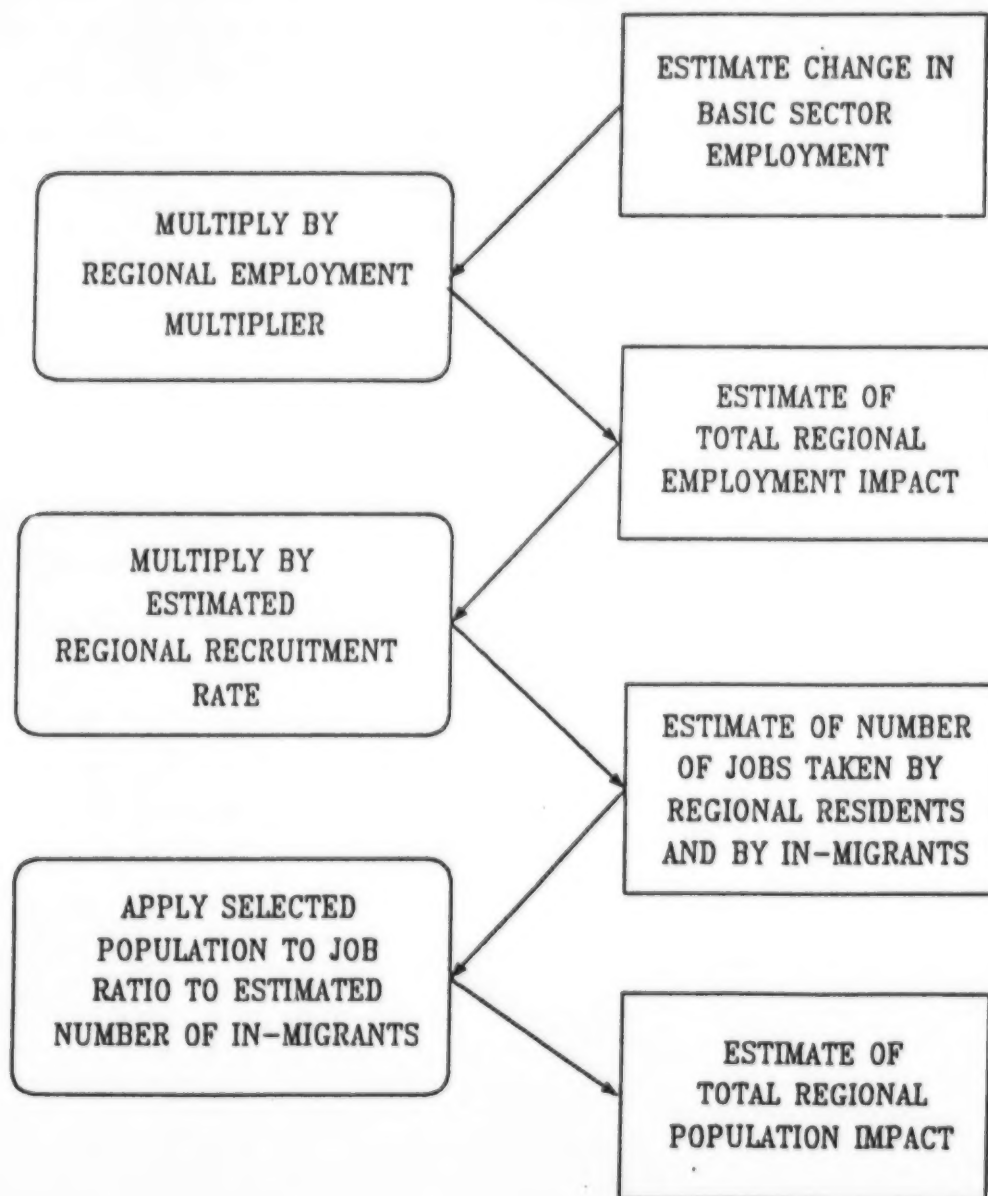
Estimating the indirect component of the multiplicand is more difficult.[5] Schwartz (1983) recommended that the analyst examine the project's detailed engineering reports and consult with the proponent to determine what proportion of the project's inputs might be purchased from within the region. The employment effect of these regional purchases can be estimated through discussions with regional business people, or by estimating the amount of regional value-added generated. In IEA, this regional value-added estimate is added to the direct income estimate to yield the multiplicand. In EBA, the regional value-added estimate is divided by an assumed average wage to produce an indirect employment estimate, which is added to the direct employment estimate to yield the multiplicand.

3. Under certain circumstances, such as when high levels of in-migration are associated with the project, the injection may also have an induced component (Yannopoulos 1973), which is the construction investment in support facilities induced by the project. In the case of mega-projects this may be an important component of the injection during the construction phase. However, in this research it is assumed that this effect was minimal by the third year of the operating phase.

4. Statistics Canada publishes average weekly wage estimates by industry and occupation; see the publication Survey of Employment, Payroll and Hours, Catalogue #72-002.

5. Project proponents rarely provide complete estimates of indirect employment.

FIGURE 1
FLOWCHART OF DEMO-ECONOMIC IMPACT ANALYSIS



The second step in regional demo-economic impact analysis is to estimate the regional economy's multiplier. The multiplier estimates the strength of income circulation within the regional economy: if there is a high level of leakage from the economy (in the form of taxes, savings and imports) the multiplier will be small, and vice versa. Regional employment or income multipliers can be estimated by selecting one from published estimates for the study region or similar regions, or a multiplier can be constructed using regional data. A detailed discussion of the wide variety of methods and data sources for estimating employment and income multipliers is provided in Appendix A.

The third step is to estimate the project's total regional economic impact by applying the multiplier to the multiplicand. The total impact can be divided into the direct, indirect and induced components by subtracting the direct, and then the indirect impact (estimated in the multiplicand) from the total impact. The regional economic impact may be expressed in terms of employment or income. However, before proceeding to the next step in demo-economic impact analysis, the income impact must be converted into an employment estimate. This may be accomplished by dividing the direct, indirect and induced income impact by appropriate wage rates.[6]

The fourth step is to estimate the regional recruitment rate for the new jobs, and thus the number of employees that can be expected to move to the region. This analysis should be completed separately for each component of increased regional economic activity, i.e. for the direct, indirect and induced jobs. Once the regional recruitment has been estimated, it is assumed the remaining jobs are filled by in-migrants.

Estimating the regional recruitment rate may be completed by examining hindsight analyses of other projects, or by analyzing the region's labour market and comparing it to the project's requirements. If the latter approach is chosen, analysts examine the participation and unemployment rates in the regional economy to estimate the current match between the regional demand and supply for labour. In particular, the participation rates suggest whether additional individuals might be encouraged to enter the labour force by new employment

6. See footnote 4 for sources of wage estimates.

opportunities. An excess of supply over demand does not necessarily mean that no in-migration will occur. If the project's skill, occupational, or geographical requirements do not match the supply in the regional labour force, there may be a high level of in-migration. Other factors, such as the level of interest in the new employment opportunities among regional residents, the hiring policies of the project proponent, whether the project will be a union site, educational or cultural barriers facing regional residents, and the potential for regional training opportunities may also affect the regional recruitment rate.

The fifth step is to estimate the population impact associated with the in-migration. A population-to-job ratio is applied to the estimated number of jobs taken by in-migrants. The ratio may be based on a regional, provincial or national average, or on hindsight analyses of other projects. Selection of an appropriate population-to-job ratio should consider the characteristics of the project, the region, and the industry, along with the expressed hiring preferences of the project proponent.[7]

EBA and IEA are commonly used in the economic portion of a demo-economic impact analysis. Both techniques, due to conceptual and practical limitations,[8] are best suited to analyzing small and relatively simple regional economies where inter-industry linkages are small. In addition, both are best suited to analyses of marginal changes in regional economic activity that will not alter the region's economic structure. Finally, use of these techniques should be restricted to short-term (5 years or less) analyses.

Generally, IEA is expected to produce more conservative, more accurate impact projections than EBA.[9] However, the accuracy of economic impact projections completed using either EBA or IEA depends on a number of factors, including:

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7. For example, some project proponents will express a preference for hiring married people.
 8. Appendix A contains a detailed discussion of the major assumptions of EBA and IEA, as well as practical difficulties that must be faced when using these techniques.
 9. The most common method used to estimate employment multipliers tends to underestimate basic employment, and so overestimate the multiplier.

- 1) the multiplicand estimate,
- 2) the multiplier estimate,
- 3) the amount of excess capacity in the region,
- 4) the nature of any time lags operating in the response of the regional economy to the project, and
- 5) the level of in-commuting, particularly in the project's direct employment.

Any impact analysis must consider the potential influence of all these factors on the projection's accuracy, but the importance of doing this is magnified when EBA and IEA are utilized in situations outside the normal range of their application.

2.2 Special Considerations Associated with the Mega-Project Context

Mega-projects are not marginal changes in regional economic activity; their direct employment may represent a substantial change in a region's total employment. For example, the NECP's projected direct employment for 1986 was approximately 20% of the region's total employment in 1981. Thus, using EBA or IEA in a demo-economic impact analysis of a mega-project is outside the range where these techniques can be expected to produce their most accurate results. Special attention is required, therefore, in estimating the parameters of the demo-economic impact analysis and in assessing how the factors listed above will influence the accuracy of the projections. For example, mega-projects have very large supply and service inputs in their construction phase and often their operating phase as well, suggesting the indirect component of the multiplicand will be very important. The difficulty of estimating this component tends to produce pre-project analyses that assume regional businesses will capture a negligible portion of the project's purchasing expenditures (Schwartz 1983). Depending on the region, this assumption can be very misleading. For example, the NECP is located in a region that has hosted several mega-projects since World War II; the regional business sector oriented to supplying the construction and resource development industries is well developed, and the proportion of the NECP's purchasing expenditures captured by these businesses could be very high. If the indirect component of the multiplicand is not included, the multiplicand estimate will be conservative.

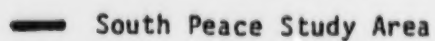
In-commuting by direct employees may depend on the project location, the overall project design, and the proponent's hiring policies. For example, with the NECP in-commuting could have been expected to be relatively low during the operating phase because a new town was constructed and the mines wanted to hire people who would move to the new town. However, if the mega-project had been located near a number of larger population centres that were not included in the study region, in-commuting might be very high and the multiplicand should be adjusted downwards.

Consideration should also be directed to how the mega-project's employment and population impacts might influence the regional economic multiplier. Employment and income multipliers are constructed using historical data and are usually assumed to remain constant over the analytical period. If a mega-project caused a change in the size of the regional market that resulted in new businesses moving into the region, the multiplier could be too conservative, particularly for medium term analyses.

Finally, excess capacity in the regional economy and time lags may be very important factors influencing the accuracy of pre-project analyses of mega-projects. Lag effects are difficult to assess, and depend on the project's and the region's characteristics. In the regional labour market analysis completed as part of the demo-economic impact analysis, some indication of excess capacity in the region may be revealed. However, whether excess capacity is taken up depends on a number of factors.^[10] Time lags are generally thought to range between 3 and 5 years, but if expectations are optimistic the lag may be shortened considerably. Generally, if excess capacity exists and is taken up, and/or if the regional economy's response is quite lagged, the impact projections will be too high.

10. These include the skill and occupation match between the demand for and supply of labour, the implementation and success rate of training programs, the level of entrepreneurship in the region's business sector, and the proponent's preferences for sourcing inputs.

SOUTH PEACE STUDY AREA



3.0 THE CASE STUDY

The NECP is the largest industrial undertaking in BC's history, involving construction of two coal mines (Quintette and Bullmoose), a new town, a rail line, a port, a high voltage transmission line, and a number of roads and highways. In addition, hundreds of kilometres of existing rail lines were upgraded. The coal mines are in the Peace River coalfields, which stretch from the small community of Hudson's Hope on the Peace River to the Alberta border to the southwest. The two mines were expected to produce 7.7 million metric tonnes per year (MMTPY) of coal, directly employing 2,053 people. Construction on this mega-project began in late 1981, and the coal mines moved into the operating phase in late 1983.

The study region is the area south of the Peace River within the boundaries of the Peace River-Liard Regional District (Figure 2); this area captures most of the people commuting to work at the mines, plus the majority of the mines', and their employees', regional purchasing. The South Peace is sparsely settled, with a large rural population; the total population of the study region was 24,522 in 1981. Before the NECP, there were two larger communities and a number of smaller, unincorporated settlements in the region. The economic history of this region is strongly influenced by mega-projects.[11]

4.0 STUDY APPROACH

The purpose of this research is to examine the relative accuracy of EBA and IEA in projecting the demo-economic impacts of a natural resource mega-project. The study was divided into three components, described below.

The first component was preparation of two 'pre-project' demo-economic impact analyses for the NECP, one using IEA and the other using EBA. The projections are for the year 1986,

11. The first mega-project was the Alaska Highway, built during WWII. In the 1950s, the Pacific Great Eastern railway and the Hart Highway were completed, connecting this region to the rest of the province. In the 1960s the huge WAC Bennett Dam on the Peace River was built, followed by the Site 1 Dam in the 1970s, and the NECP in the 1980s.

the third year of this mega-project's operating phase,[12] and are restricted to the impacts of the coal mines.[13] The 'pre-project' projections are based on information available in 1981 while the NECP was under construction. Rather than preparing the 'pre-project' analyses using standard procedures, modifications expected to improve the accuracy of these techniques are incorporated.

The second component was completion of an *ex post* analysis of the NECP's regional demographic impacts in 1986. There are numerous approaches to completing an *ex post* analysis of a project or program (Folmer and Nijkamp 1985). The preferred approach is to conduct a 100% survey of all businesses in the region and ask them to identify the proportion of their sales, value-added, and/or employment associated with the project or program, and how many of these jobs were filled by in-migrants.[14] However, this was not possible given the resource constraints on this research. Another approach is to compare the employment and population trends in the region to another region or set of region not affected by the project or program; the difference in population or employment levels are assumed to be the project's impacts. However, this assumes the region would have followed the trend in the other region or set of regions, and it does not provide any details on the accuracy of the parameter estimates used in the pre-project analyses.

To complete the *ex post* analysis, this research analyzed the NECP's employment impact using the economic base technique.[15] The direct component of the multiplicand was obtained from published information on the mines' total employment in 1986 (Shera et al.

12. In impact analysis, the construction and operating phase impacts should be analyzed separately: each phase has different factors that influence the level of expected regional demographic impacts. Also, several projections should be prepared in the pre-project analysis; these should include one based on a worst case scenario, one on a best case scenario, and one on the base case, or most likely, scenario. In this report, only the base case scenario projections are presented.

13. The coal mines are the largest component of the NECP's operating phase in terms of employment and operating expenditures.

14. The average household size of in-migrants could be obtained from a custom tabulation of Census data.

15. EBA was used because the data required was available at the time this research was completed; IEA could have been used had the required information been available.

1987). The indirect component was estimated from data obtained in personal interviews with mine management personnel and regional business people,[16] and an analysis of the regional value-added in various supply industries. The employment multiplier was estimated using custom tabulations of 1986 Census data on the distribution of the experienced labour force by industry, and information on regional transfer payments in that year. The estimate of regional recruitment in direct employment was based on a custom tabulation of 1986 Census data; for the indirect and induced employment, the Census data was supplemented with information obtained in interviews with regional business people. The population-to-job ratio for in-migrants was estimated from a custom tabulation of Census data.

The final component was comparison of the 'pre-project' and *ex post* analyses.

5.0 RESEARCH RESULTS

5.1 The Parameter Estimates for the Pre-Project Analyses

Four key parameters must be estimated to complete a pre-project demo-economic impact analysis: the multiplicand, the multiplier, the regional recruitment rates, and the population-to-job ratio. The estimates used in this research and details on their construction are presented below.

The Multiplicand Estimates

The coal companies projected that their direct employment in coal mining would be 2053 in 1986 (BC 1981). Assuming an average annual wage of \$32,000 (1981\$C) in the mining industry for that year, the direct component of the income injection in 1986 was assumed to be \$65.696 million.

16. For more details on these interviews, see Boothroyd and Knight (1990).

The indirect component of the multiplicand was estimated by analyzing:

- a) the proportion of the mines' total annual operating costs that would be spent on goods and services,
- b) the proportion of this expenditure that would flow through regional businesses, and
- c) the regional value-added by these expenditures.

This regional value-added formed the indirect component of the income injection; it was divided by an appropriate wage to estimate the number of indirect jobs which formed the indirect component of the employment multiplicand.

The detailed engineering reports for the NECP's coal mines were not available when this research was completed,[17] and so an indirect estimate of the mines' total annual expenditures on supplies and services in the operating phase was prepared. Quintette Coal Ltd.'s Stage II submission to BC's Coal Development Guidelines process estimated that the mine's total annual operating costs to produce 6.5 MMTPY of coal would be \$280 million (1981\$C) (Quintette Coal Ltd. 1982). Assuming the Bullmoose mine would experience similar unit costs, the total annual operating costs of the two mines was assumed to be \$353.256 million (1981\$C).

The proportion of the total annual operating costs allocated to goods and services was estimated using Patching et al.'s (1980) analysis of the cost structure of an average open-pit metallurgical coal mine in BC. That analysis suggested that 25% of these costs would be allocated to materials and supplies. However, this did not include on-going capital expenditures. Based on personal interviews with mine management personnel, these expenditures were assumed to average 12.5% of total annual operating costs. Thus, total expenditures on materials and services including on-going capital expenditures were assumed to be 37.5% of annual operating costs, equal to \$132.467 million (1981\$C).

17. These reports would have been available to the provincial government, and it is assumed that the information utilized in this research in preparing an estimate of the indirect component of the multiplicand would have been available in these reports, or directly from the proponents.

The proportion of the mines' purchasing flowing through regional businesses may be estimated after consulting with the proponents regarding their requirements and intentions, and with regional businesspeople regarding their capabilities and experience. For the pre-project analysis, it was estimated that 50% (\$66.234 million) of the two mines' supply purchases could be made through regional businesses because of the region's history of large construction projects, its diverse resource-base, and the proponents' stated intentions to maximize regional purchasing.

Estimating the regional value-added generated by these regional purchases requires two types of information; an estimate of project expenditures by category, and an estimate of the regional value-added in each expenditure category. The level of detail in the expenditure categories and regional value-added estimates will depend on the information available. For the NECP case, four categories of regional expenditures on goods and services were identified; manufactured, stocked and distributed, stocked but not distributed, and miscellaneous.[18] Based on personal interviews with mine management personnel, the value of the mines' purchases from regional suppliers were divided among these categories.

The amount of regional value-added in each expenditure category was assessed based on personal interviews with mine management personnel and regional business people, and a review of relevant information.[19] The expenditure categories were assigned a 'high' or 'low' regional value-added rating. High value-added ratings were given to expenditures in the manufactured and stocked and distributed categories, along with certain miscellaneous services. For these items, the regional value-added was assumed to be equal to 20% of the total expenditure. Low regional value-added ratings were assigned to expenditures in the stocked but not distributed category, some specialized service contracts, and some

18. Expenditures in the manufactured category included fuel and lubricant purchases, and fabricating and machining services. Expenditures in the stocked and distributed category included some spare part and other miscellaneous purchases, and special contracted services. Expenditures in the stocked but not distributed category included large equipment purchases and some spare part purchases. Expenditures in the miscellaneous category included contractual service agreements for janitorial and cleaning requirements, and other contracted services such as shipping.

19. In particular, the Statistics Canada publication, Small Business Profiles, provides information that can be used to estimate value-added by various types of businesses.

miscellaneous purchases. The regional value-added for the low category was assumed to be equal to 10% of the total expenditure. For the NECP, it was assumed that 67% of the mines' purchases from regional suppliers was in the 'low' regional value-added category, and 33% in the 'high' regional value-added category; thus the 'effective' regional value-added by the mines' purchases from regional suppliers was estimated to be 13.3%.

The total regional value-added associated with the mines' regional purchases was estimated by multiplying the 'effective' regional value-added estimate (13.3%) by the total regional expenditure estimate (\$66.234 million). The resulting regional value-added estimate was \$8.809 million; this is the indirect component of the income injection for 1986. To convert this to the indirect employment for that year, an average wage of \$25,000 in the regional supply industry was assumed;^[20] this regional value-added was equivalent to 352 indirect jobs.

The total number of direct and indirect jobs, i.e. the multiplicand for the economic base analysis, was estimated to be 2405. The total income injection for 1986 was estimated to be \$74.504 million.

The Multiplier Estimates

Estimating employment and income multipliers can be approached in a number of ways. A survey of the literature can be conducted and the analyst can choose a multiplier from published estimates. Tables 1 and 2 present a selection of published employment and income multipliers.

It is preferable to construct a multiplier from regional data. The analyst develops more familiarity with the regional economy, and the multiplier should be more accurate. Appendix A contains a detailed discussion of various estimation procedures for employment and income multipliers. The multiplier estimates prepared using these procedures are presented in Tables 3 and 4.

20. This is based on the Statistics Canada publication Survey of Employment, Payroll and Hours (Catalogue #72-002).

TABLE 1
SELECTED EMPLOYMENT MULTIPLIERS:
PUBLISHED ESTIMATES, 1980

Source	Location/Project	Multiplier
Weiss & Gooding 1968	Portsmouth, New England, USA	
	(private sector)	1.8
	(public sector)	1.4
Greig 1971	Scottish Highlands	
	Pulp & Paper Mill	2.1 - 2.4
Brownrigg 1973	Stirling University	
	Population = 100,000	1.36 - 1.7
Brownrigg & Greig 1975	Isle of Skye, UK	1.05 - 1.18
	Tourism	
Davis 1976	Prince George, BC	2.06
	Steel Mill	
	Population = 60,000	
Nickel et al. 1978 (all mining)	British Columbia	2.24
	Alberta	2.2
	Saskatchewan	2.30
	Manitoba	1.93
	Ontario	2.41
	Quebec	2.57
	New Brunswick	2.25
	Nova Scotia	2.47
	Prince Edward Island	1.34
	Newfoundland	3.35
	Pine Point, NWT	1.26
	Population = 2,350	
	Schefferville, PQ	1.20
	Population = 3,178	
	Grande Cache, ALTA	1.45
	Population = 3,500	
	Hinton, ALTA	1.64
	Population = 4,911	
	Malartic, PQ	1.77
	Population = 6,998	
	Wabana, NFLD	1.64
	Population = 8,028	
	Flin Flon, MAN	1.83
	Population = 11,104	
	Noranda, PQ	2.35
	Population = 11,477	
	Western Crows Nest Pass	1.69
	Population = 11,500	
	Trail, BC	2.53
	Population = 11,580	
Murdock & Leistritz 1979	Western USA	1.7 - 2.5
	Large-scale energy development in rural areas (coal mining)	
Paiching et al. 1980	Western Canada Coal Mining	
	Input-Output Model estimate	1.63
	Candide Model estimate	1.97
	Local Economic Impacts of Operational Phase	1.25 - 1.6

TABLE 2
SELECTED INCOME MULTIPLIERS:
PUBLISHED ESTIMATES, 1980

Source	Location/Project	Multiplier
Archibald 1967	Small 'Standard' Region, UK, (approx. size of Alberta)	1.25
Steele 1969	'Standard' regions, UK (approx. size of Canadian provinces)	1.09 - 1.32
Greig 1971	Scottish Highlands Pulp & Paper Mill Population < 1 million	1.44 - 1.54
Brownrigg 1973	Stirling University Stirling, Scotland Population = 100,000	1.45 - 1.8
Yannopoulos 1973	Relocation of civil service employees to regional centres in UK Reading Pop(1971)=132,937 Hemel Hempstead Pop (1971) = 69,546	1.376 - 1.408 1.355 - 1.387
Brownrigg & Greig 1975	Ile of Skye, UK Tourism	1.13 - 1.23
Davis 1976	Prince George, BC Steel Mill Population = 60,000 Kitimat, BC Steel Mill Population = 30,000 Flat Creek, BC Steel Mill Population = 4,000	1.35 1.24 1.08
Nickel et al. 1978 (all mining)	British Columbia Alberta Saskatchewan Manitoba Ontario Quebec New Brunswick Nova Scotia Prince Edward Island Newfoundland	1.58 1.85 1.42 1.48 1.86 1.83 1.43 1.59 1.53 2.00
Davis 1980	Rural fishing village in BC aquaculture program Population = 3,000 previous employed previously unemployed in-migrant	1.078 1.044 1.117
Patching et al. 1980	Western Canada Coal Mining Input-Output Model estimate Candide Model estimate Local Economic Impacts of Operational Phase	1.22 1.60 less than 1.25 - 1.6
Canadian Resourcecon Ltd. 1980	Fort St. John, BC Population approx. 12,000 Hydroelectric development	1.20

TABLE 3
EMPLOYMENT MULTIPLIER ESTIMATES:
SOUTH PEACE REGION, 1981

Technique	Estimate
1) Pick one from published estimates	1.50
2) Assumptions + L.Q. (Division-level SIC)	2.66
3) Assumptions + L.Q. (3 digit SIC)	2.44
4) Assumptions + L.Q. + Transfers (3 digit SIC)	1.54
5) Minimum Requirements (Moore equation)	1.67

where L.Q. is the location quotient,
and SIC is the standard industrial code.

The employment multiplier chosen for this analysis was 1.54, the estimate resulting from using the fourth approach in Table 3 which corrects for transfer payments into the region. This correction has been shown to dramatically improve the accuracy of economic base analysis (Gibson and Worden 1981). The multiplier suggests that for every new job created in the basic sector, 0.54 job in the service sector is created.

TABLE 4
INCOME MULTIPLIER ESTIMATES:
SOUTH PEACE REGION, 1981

Technique	Estimate
1) Pick one from published estimates	1.175
2) Weighted import coefficient	1.267
3) Disaggregated import coefficient	1.232

The income multiplier chosen for this analysis was 1.232, the estimate produced when the coefficient for the regional propensity to import is disaggregated into consumer and business propensities. This should be more accurate than when a weighted average of these propensities is used. The multiplier chosen for this research suggests that for every dollar of income injection in the study region's economy, an additional \$0.232 is generated in successive spending rounds.

The Regional Recruitment Estimates

Published information on regional recruitment rates is inadequate (Murdock et al. 1982). A report on western Canada's coal industry (Patching et al. 1980) estimated that regional recruitment may range between 25% and 50% of the total operating employment. Leistritz and Murdock (1979) reported that regional hiring in the operating phase of fourteen coal mining projects in the midwestern United States averaged 62%, but there was a very large variation between projects. The authors suggested regional recruitment rates would be higher for small projects in more populous regions. BP Canada Ltd., in its pre-project, Stage II submission to BC's Coal Development Guidelines process, estimated that 10% of the operating jobs associated with its coal property in the northeast region would be taken by regional residents. These published estimates provide little guidance in selecting a regional recruitment rate for the NECP's direct employment; the rate could potentially vary between 10% and 65%.

Given that there was a significant supply of skilled and unskilled labour in the northeast region in the 1970s (BC 1976), that the majority of direct jobs were relatively unskilled occupations, and that there was significant interest within the study region in the employment opportunities associated with the NECP (Cornerstone 1977), one might expect very high regional recruitment rates. However, the location of the coal mines, the decision to build a new town, and the tendency for mining companies to prefer employees with previous mining experience (Peat Marwick 1978) suggested that regional recruitment in the direct operating jobs would be limited. For the pre-project analyses completed as part of this research it was assumed that 15% of the direct jobs would be filled by regional residents.

None of the literature reviewed above addresses the question of regional recruitment rates for the indirect and induced employment. Given the decision to build a new town and the characteristics of the region's labour force (BC 1976), it was assumed in this research that 25% of the indirect jobs and 50% of the induced jobs would be filled by regional residents. It was assumed that most of the indirect and induced jobs located in the new town would be filled by in-migrants. Of the indirect and induced jobs located in existing communities, it was assumed that the indirect jobs would be filled by regional residents and in-migrants, but that the induced jobs would be filled exclusively by regional residents.

The Population-to-Job Ratio Estimates

The study region's population-to-job ratio was approximately 2.4 in 1976. The mining companies' indicated that they would be encouraging people with families to move to the region. For this analysis, it was assumed that the household types of in-migrants would be as follows: 20% would be single people, 40% would be couples, and 40% would be couples with two children. The population-to-job ratio for the in-migrants was assumed to be 2.6.

5.2 The Pre-Project Projections

Table 5 presents a summary of the pre-project, base case projections that resulted from the parameter estimates outlined above. As expected, IEA yielded a more conservative economic impact projection than EBA, and this conservative tendency carried through to the population impact projection. However, the impact projections based on EBA were only 3% higher than those based on IEA because of the technical innovations utilized in the EBA analysis. Without these modifications, the impact projections based on EBA would have been significantly higher (>50%) than the IEA projections.

TABLE 5
COMPARISON OF PRE-PROJECT PROJECTIONS
OF THE NECP'S REGIONAL DEMO-ECONOMIC IMPACTS:
SOUTH PEACE REGION, 1986

Variable	EBA	IEA
Multiplicand	2,405	\$74,505,000
Multiplier	1.54	1.232
Income Impact	n/a	\$91,788,928
Employment Impact	3,704	3,557*
Direct	2,053	2,053
Indirect	352	352
Induced	1,299	1,152
Regional Recruitment Rates		
Direct	15%	15%
Indirect	25%	25%
Induced	50%	50%
Number of In-migrants	2,659	2,585
Population-to-job Ratio	2.6	2.6
Population Impact	6,913	6,721

* The total income impact was converted into an employment impact as follows. The direct wage component was estimated to be \$65.696 million and was assumed to cover the wage and salary costs of 2,053 direct employees at an average annual wage of \$32,000. The indirect component of the income injection, \$8.809 million was divided by an assumed average annual wage of \$25,000 to produce an estimate of 352 jobs in the supplying industries, and the induced income, \$17.285 million, was divided by an assumed average annual wage of \$15,000 to produce an estimate of 1152 jobs in the service sector. These wages were chosen after consulting Statistics Canada publications (72-002, 93-116).

5.3 The *Ex Post* Analysis

The first step in the *ex post* analysis was to estimate the multiplicand. In 1986 there were 1,875 people employed at the two coal mines (Knight 1990; Shera et al. 1987). In 1986, the two mines' total average annual expenditures on capital equipment, supplies and services was

estimated to be \$148.887 million (1981\$C), and mine management personnel estimated that 70% of these purchases were made through regional businesses. The amount of regional value-added generated by this \$104.221 million in regional purchasing was estimated to be \$13.861 million (1981\$C).[21] The indirect employment generated by this level of regional value-added was estimated to be 554 jobs.[22] The multiplicand for 1986 was therefore 2,429 jobs.

The next step was to construct an employment multiplier. Based on 1986 data on the distribution of the region's experienced labour force by industry and regional transfer payments, the regional employment multiplier was estimated to be 1.43.[23] Applying the multiplier to the multiplicand, the total employment impact of the NECP in 1986 was estimated to be 3,473 jobs of which 1,875 were direct, 554 indirect, and 1,044 induced.

To estimate the population impact of this job creation, the number of direct, indirect and induced jobs taken by regional residents was estimated. Custom tabulations of Census data revealed that 280 regional residents were working in the coal mining industry in 1986. Therefore, 1,595 direct jobs had been filled by in-migrants. Of the 1,598 indirect and induced jobs related to the NECP, 605 were in Tumbler Ridge and 90 of these had been filled by regional residents. The remainder of the indirect and induced jobs in Tumbler Ridge had been filled by in-migrants (515). Based on personal interviews with regional business people, it was assumed that all of the 993 indirect and induced jobs located in the other communities were filled by regional residents. Therefore, in 1986 it was estimated that there were 2,110 jobs related to the NECP that had been filled by in-migrants. The population-to-job ratio for in-migrants in 1986 was 3.0; the population impact of these in-migrants was estimated to be 6,330.

21. Assuming the same pattern of expenditures and regional value-added as in the pre-project analyses.

22. Assuming an average annual wage of \$25,000.

23. For details regarding the construction of this employment multiplier, see Appendix A.

Table 6 presents a summary of the *ex post* analysis, and compares it to the pre-project projections. The NECP's employment and population impacts in 1986 were less than the pre-project projections suggested. However, the variation was less than a 10% difference, and there was a smaller variation in the employment impacts (6%), than in the population impacts (9%).

TABLE 6
REGIONAL POPULATION AND EMPLOYMENT IMPACTS OF THE NECP:
PROJECTIONS AND *EX POST* ANALYSIS, 1986

	PROJECTED IMPACTS		<i>EX POST</i> ANALYSIS
	EBA	IEA	
Employment	3704	3557	3473
Population	6913	6721	6330

6.0 DISCUSSION AND CONCLUSIONS

The two techniques compared in this research are both utilized in regional economic impact analysis, but EBA is more common. It is simpler conceptually and technically than IEA, and data required to construct an employment multiplier is available from the Census in published form. However, EBA typically over-estimates economic impacts because the employment multiplier is usually over-estimated. If a more rigorous approach to estimating the parameters in EBA is adopted, such as demonstrated in this research, the technique's accuracy can be improved. More time and money will be required for data collection and analysis, but the improved accuracy is well worth it, and the general knowledge of the regional economy gleaned from a more rigorous approach has added benefits in strengthening other assumptions made in the impact analysis.

IEA is a more complex technique than EBA, but is not necessarily more demanding in terms of data. The income multipliers constructed in this research were simple formulations and used published data sources to estimate the multiplier's parameters. Disaggregation of the

import coefficient into two components improved the accuracy of the impact projections. A major obstacle to wider utilization of IEA has been the lack of a user's manual.[24] The appendix to this report addresses this need by providing detailed descriptions of data sources and parameter estimation procedures; further amplification of other modifications and applications of IEA would also be useful. A valuable, but not widely recognized, by-product of utilizing IEA is the knowledge of the regional economy that the analyst develops, which strengthens other assumptions made in the impact analysis.

In this research, IEA and EBA yielded very similar projections of the demo-economic impacts of a natural resource mega-project. The similarity was a result of technical modifications used in the EBA technique. The employment multiplier was adjusted for transfer payments, as recommended by Gibson and Worden (1981). In addition, the multiplicand included an estimate of indirect employment, an important component of the multiplicand in the case of mega-projects. The method of estimating indirect employment proposed here modified one suggested by Schwartz (1983); a leaf from the IEA approach was borrowed, and the regional value-added by regional purchasing was analyzed to estimate indirect employment. Without these modifications, EBA would have dramatically over-estimated the impacts.

Both pre-project analyses projected higher employment impacts than the *ex post* analysis revealed. However, the variation was minor (6%), and is attributable to the smaller employment multiplier in the *ex post* analysis. The multiplicand estimate was the same in the pre-project and *ex post* analyses. This favourable multiplicand comparison, however, was coincidental, as the value of the direct and indirect components of the multiplicand differed between the pre-project and *ex post* analyses. In 1986, the mines' had lower output and direct employment levels than expected (1,875 versus 2,053). However, the effect of lower direct employment on the multiplicand estimate was masked by the higher than expected indirect employment.[25]

24. Such as Schwartz's (1983) guide for EBA.

25. Resulting from higher operating costs than expected, and a higher degree of regional purchasing by the mines than assumed.

The lower employment multiplier in 1986 might have been caused by a lag in the regional economy's response to the NECP. Given the enormous increase in regional employment represented by the NECP (approximately 20% of total employment in 1981), it would not be unreasonable to expect a significant response lag. The lag may have been exacerbated by the high turnover rate at the mines, and in the new town's population, during the first five years (1983 - 1988). The perceived isolation of the new town encouraged the new town's residents to leave the region for combined shopping/pleasure trips during these early years (Shera and Gill 1987). The mining jobs are very high wage jobs, and there is a strong possibility that leakages associated with this direct income was higher because of the new town, lessening the region's economic multiplier. This effect may dissipate as turnover lessens and the community becomes more settled; in interviews with residents of the new town, residents observed that shopping and excursion patterns were changing with the recent lower turnover rates (Boothroyd and Knight 1990). The study region's multiplier may return to its previous levels, or perhaps increase, in the future.

Both pre-project analyses also projected higher population impacts than the *ex post* analysis revealed. The variation was slightly more than observed with the employment impacts (9%), and is attributable to the large variation in regional recruitment rates and the difference in population-to-job ratios in the pre-project and *ex post* analyses. The pre-project analyses assumed a 15% regional recruitment rate for direct employment, and 44% for indirect and induced employment. The *ex post* analysis shows that the rate assumed for the direct employment was appropriate, but that regional recruitment into indirect and induced jobs was under-estimated. Regional recruitment into indirect and induced jobs was estimated to be a maximum of 68%, and is probably related to the effects of the recession in the early 1980s and the resulting excess capacity in the regional economy. The population-to-job ratio assumed in the pre-project analysis was 2.6, but the *ex post* analysis revealed that a larger population-to-job ratio would have been more appropriate (3.0). This may also be related to the recession, along with the recruiting practices of the mines. When the NECP was moving into the operating phase, several mines in western and northern Canada were closing down and the two coal mines actively recruited families from these communities to move to Tumbler Ridge. In this case, the higher-than-assumed population-to-job ratio for in-migrants

counteracted the effect of higher-than-assumed regional recruitment rates in the population impact projection. Had the population-to-job ratio been lower, the effect of the difference in assumed versus actual regional recruitment rates would have been more dramatic.

In summary, the research findings suggest that if the parameters of EBA and IEA are rigorously estimated, these techniques yield similar demo-economic impact projections. IEA produces slightly more conservative impact projections, and is less prone to serious over-estimation errors compared to EBA, but its widespread use has been hampered by the lack of a user-friendly guide.

Further, the research findings suggest that if the parameters are estimated rigorously IEA and EBA may produce accurate projections of a project's regional economic impacts, even when they are applied to situations that are outside the range where these techniques may be expected to be most accurate. In using these techniques to project the demo-economic impacts of natural resource mega-project, the key parameters are the multiplicand and the regional recruitment rates.[26] The accuracy of the multiplicand estimate will be affected by the whether the project achieves targeted production levels, and the development of regional supply linkages. During the 1970s, coal mines typically met 80% of their targeted production levels (Tex Report 1988). This type of information is necessary to assess the information provided by the project proponent. The accuracy of the estimate of the multiplicand's indirect component is influenced by regional entrepreneurship, proponent sourcing practices, the amount of excess capacity, and lags. Improving the accuracy of these estimates will be difficult without more *ex post* analyses of proponent's regional purchasing patterns. The accuracy of regional recruitment rate estimates is affected by the implementation of intended training programs, the proponent's hiring preferences, and/or legal requirements for local hiring. Other factors include excess capacity within the regional economy, and atypical design elements such as a new town. There is very limited published information on regional recruitment rates, and so like the accuracy of the multiplicand's

26. Assuming that the employment multiplier in EBA is adjusted for transfer payments, and that factors such as a recession do not seriously affect the assumed population-to-job ratio for in-migrants.

indirect component, the accuracy of regional recruitment rates would be improved by more *ex post* studies.

If IEA and EBA are applied in situations outside the range where their most accurate results would be expected, pre-project analyses could be completed using both techniques. The data requirements of the methods outlined in this research overlap, and so utilizing both techniques should not add unsurmountable time or cost burdens. If the two projections are similar, the analyst's confidence in the results is improved. In addition, both yield important insights into the nature of the regional economy under consideration which should improve the assumptions made in the rest of the impact analysis.

Several scenarios should be constructed that incorporate reasonable variations in the parameter estimates. Pre-project analyses should be completed for each scenario; analysis of the results should increase the analyst's confidence in the base case scenario, and provide important information for the planning process. Finally, more *ex post* analyses of resource development projects, including mega-projects, are required to provide a better basis for estimating the key parameters in demo-economic analyses. Only by completing *ex post* analyses can the accuracy of pre-project analyses be assessed, and improvements in methods, techniques and assumptions be made.

The importance of improving the accuracy of pre-project impact analyses is illustrated by the actual pre-project projection that was completed for the NECP (BC 1981). That analysis suggested that the NECP's total regional employment and population impacts in 1986 would be 5,133 and 10,138, respectively. In the pre-project analysis, the employment multiplier was not rigorously constructed and was considerably over-estimated, resulting in a gross over-estimate of employment impacts. In addition, despite background studies that indicated an ample supply of labour in the region, the pre-project analysis assumed very low regional recruitment rates into the indirect and induced employment opportunities, leading to a gross over-statement of population impacts. The *ex post* analysis suggests the pre-project projection completed for the BC government over-estimated the NECP's employment and population impacts by approximately 40% and 60%, respectively. The costs of these inaccuracies were

not insignificant: for example, municipalities financed new residential and industrial subdivisions, and investors opened businesses only to close them a short period later. These actions had financial and social costs that could have been significantly reduced by a more rigorous and accurate demo-economic impact analysis.

7.0 LITERATURE CITED

- Archer, B.H. 'The Anatomy of a Multiplier.' Regional Studies 10 (1976): 71-77.
- Archibald, G.C. 'Regional Multiplier Effects in the U.K.' Oxford Economic Papers (1967): 22-45.
- Ashcroft, B. and J.K. Swales. 'The Importance of the First Round in the Multiplier Process: The Impact of Civil Service Dispersal.' Environment and Planning A (1982): 16 pp.
- Boothroyd, P. and N. Knight. 'Regional Impacts of the Northeast Coal Project in B.C.' Paper presented to the 14th Meeting of the Canadian Regional Science Association, Victoria, BC, 2 June 1990.
- British Columbia. Report of the B.C. Manpower Sub-Committee on North East Coal Development. Victoria: n.p., 1976.
- British Columbia. A Regional Impact Analysis of North East Coal Development on the Peace River-Liard Regional District. Victoria: Ministry of Industry and Small Business Development, 1981.
- British Petroleum Canada Ltd. Sukunka Coal Project: Stage II Submission. Volume 3: Socio-Economic Assessment. November, 1979.
- Brownrigg, M. 'The Regional Income Multiplier: An Attempt to Complete the Model.' Scottish Journal of Political Economy 18 (1971): 281-297.
- Brownrigg, M. and M. Grieg. 'Differential Multipliers for Tourism.' Scottish Journal of Political Economy 22 (1975): 261-75.
- Canada. Economic Review. Ottawa: Department of Finance, 1980.
- Cantor, L.W., S.F. Atkinson and F.L. Leistritz. Impacts of Growth. Chelsea, Mich.: Lewis, 1985.
- Cornerstone Planning Group Ltd. Coal Employment Survey of the North East Region of British Columbia. Victoria: n.p., 1977.
- Davis, H.C. Regional Economic Analysis. Vancouver, B.C.: UBC Press, 1990.
- Davis, H.C. 'Income and Employment Multipliers for Seven British Columbia Regions.' Canadian Journal of Regional Science 9 (1986): 103-115.
- Davis, H.C. 'Income and Employment Multipliers for a Small B.C. Coastal Region.' Canadian Journal of Regional Science 3 (1980): 227-235.

- Davis, H.C. 'Assessing the Impact of a New Firm on a Small-Scale Regional Economy: An Alternative to the Economic Base Model.' Plan Canada 16 (1976): 171-176.
- Davis, H.C. and D. Webster 'A Compositional Approach to Regional Socio-Economic Impact Assessment.' Socio-Economic Planning Sciences 15 (1981): 159-163.
- Dixon, M. What Happened to Fairbanks? The Effects of the Trans-Alaska Oil Pipeline on the Community of Fairbanks, Alaska. Boulder, CO: Westview Press, 1978.
- Economic Council of Canada. A Climate of Uncertainty. Ottawa: Ministry of Supply and Services, 1980.
- Economic Council of Canada. Two Cheers for the Eighties. Ottawa: Ministry of Supply and Services, 1979.
- Folmer, H. and P. Nijkamp. 'Methodological Aspects of Impact Analysis of Regional Economic Policy.' Papers of the Regional Science Association 57 (1985): 161-181.
- Gibson, L.J. and M.A. Worden. 'Estimating the Economic Base Multiplier: A Test of Alternative Procedures.' Economic Geography 57 (1981): 146-159.
- Gillett, J.A. and A.D. Robertson. 'The Regional Employment and Population Impacts of Resource Developments.' in Kissling, C.C., M. Taylor, N. Thrift and C. Adrian (eds.). Regional Impacts of Resource Developments. Sydney, Aust.: Croom Helm, 1984.
- Gilmore, J.S., D. Hammond, K.D. Moore and J.F. Johnson. Socioeconomic Impacts of Power Plants. Prepared for the Electric Power Research Institute, Palo Alto, California, February 1982.
- Greig, M.A. 'The Regional Income and Employment Multiplier Effects of a Pulp Mill and Paper Mill.' Scottish Journal of Political Economy 18 (1971): 31-49.
- Gunton, T. 'A Practitioner's Guide to Economic and Population Impact Assessment.' Burnaby, B.C.: Simon Fraser University, n.d. (Mimeo)
- Hewings, G.J.D. 'Problems of Integration in the Modelling of Regional Systems.' in Batey, P.W.J. and M. Madden (eds.). Integrated Analysis of Regional Systems. London: Pion, 1986.
- Hoover, E.M. An Introduction to Regional Economics. New York: Knopf, 1971.
- Isserman, A.M. 'Economic-demographic Modelling with Endogenously Determined Birth and Migration Rates: Theory and Prospects.' Environment and Planning A (1985): 21 pp.
- Isserman, A.M. 'Projection, Forecast, and Plan: On the Future of Population Forecasting.' Journal of the American Planning Association (1984): 208-221.

- Isserman, A.M. 'Estimating Export Activity in a Regional Economy: A Theoretical and Empirical Analysis of Alternative Methods.' International Regional Science Review 5 (1980): 155-184.
- Isserman, A.M. 'A Bracketing Approach for Estimating Regional Economic Multipliers and a Procedure for Assessing Their Accuracy.' Environment and Planning A 9 (1977a): 1003-1011.
- Isserman, A.M. 'The Accuracy of Population Projections for Subcounty Areas.' Journal of the American Planning Association (1977b): 247-259.
- Keyfitz, N. 'Can Knowledge Improve Forecasts?' Population and Development Review (1982): 730-751.
- Kissling, C.C., M. Taylor, N. Thrift and C. Adrian (eds.). Regional Impacts of Resource Developments. Sydney, Aust.: Croom Helm, 1984.
- Kreuckeberg, D.A. and A.L. Silvers. Urban Planning Analysis: Methods and Models. 1974.
- Ledent, J. 'Regional Multiplier Analysis: A Demometric Approach.' Environment and Planning A 10 (1978): 537-560.
- Ledent, J. and P. Gordon. 'A Framework for Modelling Interregional Population Distribution and Economic Growth.' International Regional Science Review 6 (1981): 85-90.
- Leistritz, F.L. and S.H. Murdock. The Socioeconomic Impact of Resource Development: Methods for Assessment. Boulder, Colo.: Westview Press, 1981.
- Madden, M. and P.W.J. Batey. 'Achieving Consistency in Demographic-Economic Forecasting.' Papers of the Regional Science Association 44 (1980): 91-106.
- Massey, D. 'The Basic:Service Categorization in Planning.' Regional Studies 7 (1973): 1-15.
- Mathur, V.K. and H.S. Rosen. 'Regional Employment Multipliers: A New Approach.' Land Economics 50 (1974): 93-96.
- Moen, E.W. 'Voodoo Forecasting: Technical, Political and Ethical Issues Regarding the Projection of Local Population Growth.' Population Research and Policy Review (1984): 1-25.
- Moore, C.L. 'A New Look at the Minimum Requirements Approach to Regional Economic Analysis.' Economic Geography 51 (1975): 350-356.
- Murdock, S.H. and F.L. Leistritz. Energy Development in the Western United States: Impact on Rural Areas. New York: Praeger, 1979.

Murdock, S.H., F.L. Leistritz and E. Schriener. 'Local Demographic Changes Associated with Rapid Growth.' in Weber and Howell (eds.). Coping with Rapid Growth in Rural Communities. Boulder: Westview Press, 1982.

Mulligan, G.F. and L.J. Gibson. 'Regression Estimates of Economic Base Multipliers for Small Communities.' Economic Geography 60 (1984): 225-237.

Nickel, P.E. et al. Economic Characteristics of the Canadian Mining Industry. Kingston: Centre for Resource Studies, 1978.

Norcliffe, G.B. 'Using Location Quotients to Estimate the Economic Base and Trade Flows.' Regional Studies 17 (1983): 161-168.

Patching, T.H., J.M. Harrison, I. Mackay and R.A.D. Beck. Western Canada's Coal: "The Sleeping Giant". Calgary: Canada West Foundation, 1980.

Peat Marwick and Partners. Manpower Development and Promotion in the Coal Mining Industry. Prepared for the Federal-Provincial Manpower Sub-Committee on North East Coal Development, January 1978.

Perkins, F. 'The Impact of the Coal-Based Developments in the Hunter Valley on the Regional Labour Market.' in Kissling, C.C. et al. (eds.). Regional Impacts of Resource Developments. Sydney, Aust.: Croom Helm, 1984.

Pittenger, D.B. 'Population Forecasting Standards: Some Considerations Concerning Their Necessity and Content.' Demography (1977): 363-368.

Quintette Coal Ltd. Quintette Stage II Report. Volume 4: Socio-Economic Assessment, 1982.

Richardson, H.W. 'Input-Output and Economic Base Multipliers: Looking Backward and Forward.' Journal of Regional Science 25 (1985): 607-661.

Schwartz, H. A Guide to Regional Multiplier Estimation. Ottawa: Ministry of Supply and Services, 1982.

Shaffer, R. 'A Test of the Differences in Export Base Multipliers in Expanding and Contracting Economies.' Regional Science Perspectives 13 (1983): 61-74.

Shahidsaless, S., W. Gillis and R. Shaffer. 'Community Characteristics and Employment Multipliers in Non-Metropolitan Counties, 1950-1970.' Land Economics 59 (1983): 84-93.

Shera, W. and A. Gill. An Evaluation of the Planning and Development of Tumbler Ridge. Victoria BC: November 1987.

Shera, W., A. Gill and A. LeBlanc. Tumbler Ridge: A Community Profile. Victoria BC: December 1987.

- Simmons, J. 'Population Forecasting: How Little We Know.' Plan Canada 21 (1981): 75-84.
- Sinclair, M.T. and C.M.S. Sutcliffe. 'The First Round of the Keynesian Regional Income Multiplier.' Scottish Journal of Political Economy 25 (1978): 177-186.
- Smith, E.D., M.M. Hackbart and J. van Veen. 'A Modified Regression Base Multiplier Model.' Growth and Change 12 (1981): 17-22.
- Steele, D.B. 'Regional Multipliers in Great Britain.' Oxford Economic Papers (1969): 268-292.
- Steele, D.B. 'A Numbers Game (or the Return of Regional Multipliers).' Regional Studies 6 (1972): 115-130.
- The Tex Report. Coal Manual 1988. Tokyo: The Tex Report, 1988.
- Thompson, J.S. 'Patterns of Employment Multipliers in a Central Place System: An Alternative to Economic Base Estimation.' Journal of Regional Science 23 (1983): 71-82.
- Tiebout, C.M. The Community Economic Base Study. Supplementary Paper #16. Published by the Committee for Economic Development, New York, 1962.
- van Dijk, J. and J. Oosterhaven. 'Regional Impacts of Migrants' Expenditures: An Input-Output / Vacancy-Chain Approach.' in Batey and Madden (eds.). Integrated Analysis of Regional Systems. London: Pion, 1986.
- Wachs, M. 'Ethical Dilemmas in Forecasting for Public Policy.' Public Administration Review 42 (1982): 562-569.
- Wegener, M. 'Integrated Forecasting Models of Urban and Regional Systems.' in Batey and Madden (eds.). Integrated Analysis of Regional Systems. London: Pion, 1986.
- Weiss, S.J. and E.C. Gooding. 'Estimation of Differential Employment Multipliers in a Small Regional Economy.' Land Economics 44 (1968): 235-244.
- Wilson, J.H. 'Impact Analysis and Multiplier Specification.' Growth and Change 8 (1977): 42-46.
- Yannopoulos, G. 'Local Income Effects of Office Relocation.' Regional Studies 7 (1973): 33-46.

5

APPENDIX A

REGIONAL ECONOMIC IMPACT ANALYSIS USING EMPLOYMENT AND INCOME MULTIPLIERS:

THEORETICAL BASIS AND EMPIRICAL ESTIMATION

INTRODUCTION

Completing an impact analysis of a project consists of three general steps. First, a baseline, without-project projection of the conditions of interest in the study area is made. Then the impacts of the project or program on these conditions are estimated. Finally, these impacts are joined with the baseline projection to produce a new statement about these conditions should the project go ahead.

In regional economic impact analysis, the conditions of interest are usually employment impacts, and the baseline projections are often completed by assuming historical patterns will continue in the region.[27] In remote or rural regions, the regional economic impacts of a project are usually estimated using multipliers. Two techniques are suited to constructing multipliers in such a situation: economic base analysis and income expenditure analysis.[28] Through economic base analysis an employment multiplier can be constructed; with income expenditure analysis either income or employment multipliers can be constructed.

THE THEORETICAL BASIS OF EMPLOYMENT AND INCOME MULTIPLIERS

Definitions

Regional economic activity can be measured in a number of ways. In this discussion it will be defined as regional income (Y), which is described as:

27. For guidance in preparing base case population projections, see Kreuckeberg and Silvers (1974), Isserman (1977b), and Isserman (1984). For a discussion of the linear, additive assumptions usually employed in preparing the with-project scenario, see Dixon (1978) and Moen (1984).

28. Input-output analysis is not included because of the large data and time requirements. Generally, regional sales and trade data required for an input-output analysis are not available and must be collected in a survey.

$$Y = C + I + G + E - M \quad (1)$$

where C is consumption
 I is investment
 G is government spending
 E is exports, and
 M is imports.

The regional economic impacts of a project may be disaggregated into direct, indirect and induced impacts. Direct impacts are associated with the project itself; the direct impact is the employment or income generated by the project's expenditures on wages. Indirect impacts are associated with activities that supply inputs to the direct activity. Induced impacts are associated with activities that support individuals employed in the direct and indirect activities; induced impacts result when the income earned in the direct and indirect activities is spent.

Economic Base Analysis

Economic base analysis can be used to project the change in total employment resulting from an increase in exports from the region. The technique focuses on the relationship between employment in the basic and non-basic sectors in a regional economy, usually using employment figures as a proxy for economic activity levels.

Briefly, the analyst begins by assigning existing employment in the region to either the basic or non-basic sector using one of several possible sectoring methods. The total employment in each sector is calculated and the ratio of non-basic or total employment to basic employment derived (the multiplier). This ratio is then applied to the increase in basic jobs expected because of the increase in regional exports (the multiplicand) to yield either the total new non-basic jobs, or total new regional employment expected.

The simplicity of this technique and the reasonably good availability of data on the distribution of the labour force across industries make economic base analysis a popular method of economic impact analysis. However, numerous assumptions and complications which limit its validity and accuracy.

The major premise of economic base analysis is that the variable E, or exports, in equation (1) is the most important, in fact the **only**, variable determining Y, or regional income. The regional economy is divided into:

$$Y = B + NB \quad (2)$$

where B is the **basic sector**, defined as all activity which serves the export market, and NB is the **non-basic sector** defined as all activity which serves the local market.[29] Distinguishing between these two sectors requires a more rigorous definition of basic activity.

29. This sector has a variety of titles in the literature, including non-basic, residentiary, service and local.

Those firms that produce, transfer and distribute goods and services whose final market is outside the region are considered to be in the basic sector. The key phrase is 'final market'; it means that all firms who produce, transfer and distribute intermediate goods and services that are incorporated into goods or services that are exported are included in the basic sector.[30] Thus the basic sector is comprised of the direct and indirect activities of the region's export sectors.

Following from the premise that exports are the sole engine of regional economic growth, activity in the non-basic sector is deemed dependent on activity in the basic sector. This relationship is assumed to be constant over the period of analysis, such that

$$K_e = (B+NB)/B \quad (3)$$

therefore,

$$Y = K_e * B \quad (4)$$

Total regional income is thus dependent on the level of activity in the basic sector, and the multiplier, K_e , describes the relationship. The multiplier's magnitude is determined by the characteristics of the spending and respending cycle that occurs within the regional economy. For example, if activity in the basic sector increased due to some increase in external demand for its products, the basic sector would pass on this stimulus to the rest of the regional economy through its technical and consumption linkages, buying more technical inputs and hiring more workers who then consume more. The strength of these linkages is affected by the leakages from the regional economy in the form of imports, taxes, and savings. If leakages are high, the respending cycle will quickly attenuate and the multiplier will be small. If leakages from the regional economy are small, the multiplier will be larger.

Economic base analysis has five major assumptions.

- 1) By assuming exports are the sole source of economic growth, the technique ignores other possibilities, such as investment, government spending, and import substitution, and may overemphasize the future role of exports in the regional economy (Massey 1973, 4).
- 2) This technique assumes the basic sector is homogeneous. In positing a single multiplier relationship between the basic and non-basic sectors, export base analysis ignores the possibility that different regional export industries may have substantially different technical and consumption linkages.

30. Massey (1973) and others have criticized this definition because it can be logically extended to include every firm in the region. This is rectified by defining the basic sector to include all firms who produce, transfer or distribute goods and services destined for export markets, and those firms which are technically linked to them. The non-basic sector is defined by consumption linkages where owners and employees spend wages and salaries on consumption goods. For a discussion of technical and consumption linkages in a regional economy, see Hoover (1971).

- 3) The multiplier is assumed to remain constant during the period of the impact analysis. This ignores the possibility of productivity changes in either sector, or import substitution, which would change the employment ratio between the basic and non-basic sectors. Consequently, the impact analyses are most powerful when the time period is short, and the change in basic sector activity is marginal.
- 4) Economic base analysis assumes there is no interregional feedback resulting from increased export levels.[31] To the extent there is interregional feedback, impacts will be understated.
- 5) This technique assumes there are no capacity constraints within the region, and so the stimulus generates growth and not inflation.

Several practical difficulties must be faced when using economic base analysis in regional economic impact analysis.

- 1) The unit of measurement for economic activity, although potentially ranging from output to value added, is generally employment, and there are several problems in using jobs as a proxy for economic growth. First, there can be increases in productivity produced by the substitution of capital for labour in an exporting industry which, while potentially increasing regional income, leads to a decline in the number of jobs in the basic sector. Second, employment figures may include part-time and seasonal jobs, and these should be adjusted to full-time-equivalents (FTE). Finally, information on employment by industry is not published in Canada; one must use experienced labour force by industry data, which includes employed and unemployed individuals and could produce a bias in the multiplier estimate if unemployment is not equally distributed across industrial sectors.
- 2) The technique assumes the economy moves from one equilibrium position (pre-stimulus) to another (post-stimulus). If the economy was not in equilibrium pre-stimulus, the data collected on employment levels in the two sectors of the economy, and the resulting multiplier estimate may be in error. In addition, the analysis provides little insight on the nature or duration of any lags to expect.[32]

31. Interregional feedback occurs when the extra regional income produced by increased exports results in increased imports from other regions, which increases their regional incomes and potentially further increases their demand for exports from the first region.

32. Richardson (1985, 635) suggests lags will vary between and within sectors over time, depending on factors such as capacity constraints, inventory management, and firms' policies. Mulligan and Gibson (1984, 225) argue lags are one of the important issues in economic base analysis that relatively little is known about. They suggest that in addition to capacity constraints, the composition of the shifting basic activity, the direction of the shift, and the responsiveness of migration and labour force participation to regional changes in wage levels and job vacancies likely play an important role in determining the nature and length of lags. Gunton (pers. comm.) suggests expectations can also play a part in shaping the nature of lags. Pessimistic expectations may weaken the response to a stimulus, and lengthen the lag; optimistic expectations may make lags short and responses strong.

- 3) Usually, public and private transfer payments are ignored in economic base analysis (Gibson and Worden 1981, 146), and consequently the technique often overestimates multipliers.[33] If transfer payments play a role in the regional economy, as they do in most Canadian regions, some of the non-basic sector employment will be linked to this income and not to the consumption of those employed in the basic sector.[34] The employment multiplier should be adjusted to reflect these transfers.
- 4) Sectoring the regional economy is the most crucial and most controversial aspect of constructing an employment multiplier. It is difficult to correctly identify the basic sector so that all directly and indirectly exporting activity is included. The major sectoring alternatives are:

Assumptions, which rely on the analyst's in-depth knowledge of the regional economy to identify basic activity,

Survey, of all businesses and households to identify direct and indirect exports, which is expensive and time-consuming,

Location Quotient, which compares the regional and national economic structures to determine regional specializations, and the region's specialization, or excess over the national average, is considered to be export employment,

Minimum Requirements, which establishes minimum employment levels by industry for similar-sized regions and equates any excess to export employment, and

Econometric, which links export-based employment to employment in the 'rest of the world' in a time-wise linear regression analysis, and predicts basic employment using this equation.

These alternatives, reviewed in detail by Isserman (1980), all have weaknesses and so the choice of an appropriate method can be difficult. Schwartz (1983) argued that, for small regional economies in Canada, the best approach was to combine judgement with the location quotient technique, and he recommended use of detailed experienced labour force by industry data (to 3-digit Standard Industrial Code) in estimating location quotients.

33. In an empirical test of the significance of this effect, Gibson and Worden (1981, 152) found an average decline of 25% in multiplier estimates once they were adjusted for public transfers; the largest declines were in retirement communities, the smallest in 'heavy industry' communities. Smith et al. (1981) also found a strong upward bias in multiplier estimates if transfer payments are omitted from the basic sector calculations.

34. Estimates of private and public transfers into regional economies in Canada are available and can be used to overcome this practical difficulty with ease (*Income Estimates for Sub-Provincial Areas*, Statistics Canada Cat.#13-216). See a later section of this appendix for a discussion of this procedure.

- 5) Finally, estimating the employment multiplicand can be difficult. The direct component of the multiplicand may be supplied by the project proponent, but rarely are complete estimates of indirect employment available. Indirect employment can be estimated as follows: first, estimate the value of project expenditures on supplies and services that will occur through regional businesses; second, estimate the regional value-added in these businesses; third, multiply the regional project expenditures by the value-added estimates and sum to produce a total regional value-added estimate; and fourth, divide the total regional value-added estimate by an assumed average wage in the region's supply and service sector.

The conceptual and practical limitations of economic base analysis suggest that this technique is best suited to analysis of small regional economies with a narrow export base. In these economies autonomous investment is usually small, local inter-industry linkages are minor, and import substitution possibilities are limited by the size of the market. Further, this technique is best-suited to analysis of short-term, marginal changes in export levels which do not change the region's economic structure. Nevertheless, this technique continues to be widely used in analyses of the economic impacts of a broad range of projects.

The accuracy of projections made using economic base analysis will depend on the accuracy of the estimate of basic employment, the method and data used to sector the economy,^[35] the amount of excess capacity in the region, the nature of any lags, and the level of in-commuting. In addition, the number of jobs taken by regional residents versus in-migrants and the resulting population increase may affect the nature and level of regional non-basic activity. Finally, the ability of employment measures to capture increases in economic activity, including changes in the capital/labour ratios in the economy will affect the accuracy of the projections.

Income Expenditure Analysis

Income expenditure analysis is a more complex technique than economic base analysis. It uses income instead of employment to measure economic activity levels, and focuses on the propensities of regional businesses and employees to purchase locally and so recycle income within the regional economy. The technique thus requires and provides details regarding economic linkages and leakages.

The procedure, described briefly, is to project the change in total regional income associated with an injection of new income into the economy. The analyst estimates how much of the initial injection becomes regional value-added (the multiplicand), and then what proportion is recycled in successive spending rounds and what proportion 'leaks' out of the regional economy (the multiplier). The respending process determines the size of the income

35. Or alternatively the assumptions and adjustments employed in choosing a published estimate from the literature.

multiplier,[36] which is applied to the injection to yield the total change in regional income.

Income expenditure analysis is a flexible technique, and in using it the analyst develops some familiarity with the regional economy. However, the data required to estimate several important parameters is often not readily available and can be costly to collect. In addition, the technique has several assumptions which limit its validity and accuracy.

The premise of income expenditure analysis is that a money injection into a regional economy will cause an increase in the level of regional income by some multiple of the original injection. The money injection can come from any of the components of regional income: consumption, investment, government spending, exports, or reduced imports.

$$Y = C + I + G + E - M \quad (5)$$

In the short term, consumptions and imports are assumed to be the major determinants of the regional responding cycle: investment, government spending, and exports are assumed to be constant and I_0 , G_0 , and E_0 , respectively.

$$Y = C - M + (I_0 + G_0 + E_0) \quad (6)$$

The multiplier effect is produced by the responding process; as income is spent in the regional economy, it becomes income for the people who provided the goods and services that were purchased, and they in turn spend some of that income in the regional economy and it again becomes income for people, and so on. The magnitude of the multiplier effect is determined by the leakages from the regional economy in the form of taxes, savings and imports.

The proportion of income spent on consumption is determined by how much is collected in direct taxes, and how much is allocated to savings. Once direct taxes are removed, people divide their disposable income between savings and consumption.[37] Their propensity to consume is the proportion of disposable, or after-tax, income which is allocated to consumption.

$$C = c_0 + c_1(Y - t_d Y) \quad (7)$$

Of the income allocated to consumption, a proportion leaves the region through payments for imported goods and services. Imports occur in two ways, through consumer imports and business imports. When people take holidays in other regions, or when they make shopping trips outside the region, they are consuming non-locally provided commodities. This is the consumer import component. Regional businesses generally import some of the goods or services they provide to their customers. These business imports are the second component of total imports in a regional economy. The weighted average of these two components,

36. Income multipliers can be converted to employment multiplier by assuming an employment/wage ratio.

37. In income-expenditure analysis, consumption is usually assumed to vary linearly with disposable income.

expressed as a proportion of disposable income, is the propensity to import within the regional economy.

$$M = m_0 + m_1(Y - t_d Y) \quad (8)$$

Once the propensity to consume and to import have been estimated, the income multiplier can be calculated.

$$K_y = 1 / (1 - (1 - t_d)(c_1 - m_1)) \quad (9)$$

where t_d is the marginal tax rate
 c_1 is the marginal propensity to consume
 and m_1 is the marginal propensity to import

As the denominator of the income multiplier estimates the proportion of income 'leaked' from the regional economy, the multiplier estimates what proportion of the original injection remains in the regional economy.

There are several important assumptions and practical difficulties that influence the applicability of income expenditure analysis. The four major assumptions are:

- 1) The coefficients of the multiplier, (c_1 , m_1 , and t_d), are constant over time, across the individuals or groups receiving increased income, and by community types. It is generally agreed that coefficients do vary across groups, and can change with structural shifts in the regional economy.
- 2) Each producing sector is homogeneous, and so the product mix problem is negligible. This is particularly important in estimating the import propensity of regional businesses, as generally one estimate of regional value-added is applied to all businesses in a particular sector, when in fact there could be substantial variation in regional value-added among those businesses.
- 3) Capacity constraints are negligible so that the economic stimulus produces growth and not inflation.
- 4) There is negligible inter-regional feedback. The data required to estimate the effect of this factor are inter-regional trade flows, which are usually not available at the regional level in Canada, and consequently this factor is usually ignored. It would be important if the region was responsible for a large share of national income yet had a low degree of self-sufficiency; in this case an increase in regional income would stimulate an increase in imports, which would stimulate other regional economies and their level of imports from the first, and other, regions.

Several practical difficulties hamper the use of income expenditure analysis in impact analysis.

- 1) Obtaining regional data to estimate marginal coefficients is difficult and expensive, and using averages will yield biases when applied to the increased income that accrues to regional residents.[38]
- 2) Estimating the import coefficients is a knotty problem plagued by lack of suitable data. Analysts usually employ data on consumer expenditures by category and match these to estimates of regional value-added by businesses in each category. Until recently, data to estimate regional value-added was relatively unavailable in Canada, but the new Statistics Canada publication, Small Business Profiles, addresses this problem.[39] Nevertheless, it remains the most difficult parameter to estimate in the income multiplier, and becomes particularly difficult when dealing with regional economies that have a strong manufacturing base that supplies local consumption.
- 3) If formerly unemployed individuals take new jobs associated with the money injection, losses in transfer payments should be deducted from the injection or multiplicand. However, it is very difficult to predict how many jobs will be taken by previously unemployed people,[40] and so this factor is often left out of multiplier formulations.
- 4) Where there is substantial immigration associated with the injection, accounting for the accelerating effect of induced investment is important, especially when there is little excess capacity in the region and little chance of increasing utilization through factor substitution (Brownrigg 1973). Unless the in-migration continues over an extended period of time, the induced investment effect will be temporary and should be handled by adjusting the multiplicand, or injection, to reflect the additional income invested.[41]
- 5) Adjusting the injection, or multiplicand, to account for initial leakages is very important, especially when the regional capital goods industry is weak. Brownrigg (1973) noted that conventional multiplier theory only deals with leakages occurring

38. This is because the additional income accruing to regional residents is a marginal increase in their income level, and should have marginal coefficients applied to it. Marginal income increases are taxed at a higher rate, more may be allocated to savings, and the consumed portion may have a higher import coefficient. The income accruing to in-migrants, on the other hand, is not a marginal increase; their entire income represents an addition to the regional economy and its impact should be estimated using average coefficients.

39. For a discussion of estimating 'm₁' with and without this data source, see later sections in this Appendix.

40. Steele (1972) suggested the level of transfer payments varies inversely with regional income, but did not find a strong statistical relationship using national data for the United Kingdom. Davis (1980) criticizes this relationship for its implicit assumption that the unemployed get the new jobs. If the new jobs go to in-migrants, regional income will still increase but the level of transfer payments will not decline.

41. Using empirical data from the University of Stirling in Scotland, Brownrigg (1973) argued induced investment is most important during in-migration and can increase the impact on regional income by 20%; otherwise it is negligible. Because of its temporary characteristics, Brownrigg suggested this effect should be included in the multiplicand (the injection), not the multiplier.

during the process, but that it is very likely the initial injection is subject to substantial leakages before it enters the regional economy.

- 6) Employing different coefficients for the first and subsequent spending rounds may be appropriate. Sinclair and Sutcliffe (1978) argued that the pattern of expenditures in the first round is atypical, usually being concentrated in one sector of the economy. In addition, in cases where there is large in-migration associated with the injection, or the injection is concentrated on certain residents, average propensities should be used in estimating the income multiplier. In later rounds, expenditures become more diffuse within the economy and are more influenced by normal community patterns. Marginal propensities should be used to calculate the income multiplier of these subsequent expenditure rounds. However, others have argued that the first round is the most important to estimate accurately especially where the regional multiplier is small (Wilson 1977; Ashcroft and Swales 1984).
- 7) Converting income multipliers to employment multipliers can be accomplished but rather gross assumptions, such as an average wage:job ratio for the region, are required. Davis (n.d., 60) suggests there are at least three possible variations which add some sensitivity to the conversion: use of industry wage rates for different components of the income impact, use different wage rates for the first and subsequent spending rounds, and use of average or marginal wage rates for income received by different groups. The simplest way is to assume there is no difference between first and subsequent rounds, nor between average and marginal wages and adjust solely for variations by industry or sector. This can be done using a weighted average of jobs:wage (Greig 1971), or by calculating disaggregated employment multipliers, such as:

$$K_e = (K_y - 1) \frac{\text{ave. wage sector } i}{\text{ave. wage service sector}} + 1 \quad (11)$$

where

K_e is the employment multiplier

K_y is the income multiplier

The strengths and weaknesses of income expenditure analysis limit the situations to which it can be validly applied. Similar to economic base analysis, it is more appropriate to use this technique to analyze the impact of incremental changes in the economic activity of small, simple regional economies that have low levels of intersectoral linkages.

Summary

Economic base analysis has several important limitations. Employment is generally an insensitive proxy for economic activity levels, the methods available for sectoring the economy all have significant drawbacks, the multiplier is usually highly aggregated and insensitive, and the technique is based in a comparative statics model. In estimating the multiplicand, analysts often rely on direct employment estimates provided by the company,

and ignore indirect employment effects; this makes the multiplicand an underestimate. In estimating the multiplier, data on experienced labour force by industry should be disaggregated to the 3 digit SIC level and this can only be obtained by placing a special order with Statistics Canada which has temporal and financial costs, and the multiplier should be adjusted for transfer payments entering the regional economy. Otherwise, the multiplier will be an overestimate.

Income expenditure analysis is an improvement over economic base analysis because it uses a more sensitive measure of economic activity - income.[42] However, the use of this technique is hampered by the difficulty of estimating the multiplier coefficients, particularly the import parameters. If the data are available, income expenditure analysis should be more accurate than economic base analysis. In addition, income expenditure analysis has more policy relevance due to its broader conceptual basis and greater elaboration of the regional economy. The flexibility of this technique to account for induced investment, loss of transfer payments, leakages from the injection, and variation by socio-demographic groups of wage levels and expenditure patterns makes it more applicable to a broader range of regional economies and projects than economic base analysis.

This appendix now turns to a discussion of various approaches to constructing employment and income multipliers, and provides details regarding data sources and methods for each approach. In general, these approaches are suitable for use in small regional or local economies that are not strongly influenced by, or are not in close proximity to, a metropolitan area. The approaches and data are discussed using the example of the NECP; the impact of the two coal mines during their operating phase on the South Peace region was the focus.

42. This is lessened somewhat by the proxies used to estimate the regional value-added in expenditure rounds.

EMPIRICAL ESTIMATION OF EMPLOYMENT AND INCOME MULTIPLIERS

Constructing Employment Multipliers using Economic Base Analysis

Several approaches are available for constructing employment multipliers. Given the usual constraints of time and money, this section examines five relatively simple approaches to constructing employment multipliers. All but the first and fifth focus on the data and techniques used to sector the economy into basic and non-basic activity. They are:

- 1) choosing a multiplier from published estimates,
- 2) using published Census information on experienced labour force by industry and a combination of judgement and location quotients to sector the regional economy,
- 3) using specially-ordered, more detailed Census information on experienced labour force by industry and a combination of judgement and location quotients to sector the regional economy,
- 4) adjusting the results from 2) or 3) above for transfer payments, and
- 5) using a generalized minimum requirements estimate, based on Moore's (1975) equation.

The first approach reviewed here is to choose a multiplier from a list of published estimates. The choice should be based on similarities between the region for which the published estimate was prepared and the study region. Table 1 in the report presented a selection of employment multiplier published prior to 1981; Table A1 updates this information to 1986.

If the analyst reviews a sufficient number of studies that provide a broad range of regional characteristics, there is a reasonable probability that a defensible multiplier will be chosen. However, because of the range in the published estimates it is also probable that different, yet equally defensible, multipliers could be chosen. In this case a high and a low estimate should be selected and used in providing a range of employment impacts. The published estimates, presented in Table A1 above and Table 1 in the report, suggest that a reasonable range for the South Peace in 1981 would have been 1.4 to 1.6.

TABLE A1
EMPLOYMENT MULTIPLIER ESTIMATES

Source	Project/Location	Multiplier
Murdock & Leistritz 1981	western rural USA, multi-county areas; with some jobs in neighboring counties	1.7-2.5
Gibson & Worden 1981	small towns in Arizona, Pop.=2,000-15,000: non-adjusted; adjusted for transfers; adjusted for transfers, wage differences & out-commuters	1.29-2.57 1.27-1.76 1.13-1.68
Gilmore et al. 1982	western rural USA: sparsely settled areas; moderately populated areas; areas near metropolis;	1.3-1.5 1.4-1.6 1.6-1.8
Schwartz 1983	Cape Breton, NS Labour force =40,235	2.24
Ashcroft & Swales 1984	South Glamorgan, Wales Pop.(1971)=390,269 Cleveland, North Region Pop.(1971)=567,766 relocation of 4,020 and 3,000 civil service jobs, respectively	1.71 1.66

The second approach is to use information on the distribution of the experienced labour force across various industries within the regional economy.[43] This information is collected in the national Census and is published for most municipalities and rural areas in Canada. To sector the regional economy into basic and non-basic activity, the most appropriate method for small rural areas in Canada is to combine judgement with the use of location quotients

43. It is preferable to have information on employment by industry group, but this is not published by Statistics Canada.

(Schwartz 1983). Using this approach produced a multiplier estimate of 2.66 for the South Peace study region. The details are presented below.

Primary Sector: assume all labour force is basic = 1,740

Secondary Sector: assume all labour force is basic, as most are in wood manufacturing = 920

Construction: use a location quotient to estimate the labour force in the basic sector, with Canada as the larger region = 494

Transportation, Communication and Utilities: use a location quotient to estimate the labour force in the basic sector, with Canada as the larger region = 615

Trade: use a location quotient to estimate the labour force in the basic sector, with Canada as the larger region = 301

Finance, Insurance and Real Estate: assume all labour force is in non-basic sector, and double check by comparing to provincial location quotient

Government: assume 0.67 of labour force are in the basic sector = 456

Services: assume all are in the non-basic sector.

$$K_e = 12,050/4,526 = 2.66$$

The employment multiplier estimated using this data source will be an overestimate because of the degree of aggregation in the industry codes. The estimate could be used as an upper bound, as recommended by Isserman (1977), but it is not advisable to use this estimate if it has not been adjusted for the impact of transfer payments.

The third approach to constructing an employment multiplier is to order more detailed data on the region's experienced labour force in various industry categories from Statistics Canada. The Census Custom Products Services in the Census Operations Division will provide data on the experienced labour force by industry to the 3-digit level of disaggregation in the Standard Industrial Code.[44] There is a charge for the data (minimum of \$300.00), and a waiting time for the results (minimum of 4 weeks). These data were used to re-estimate the employment multiplier for the South Peace in 1981, again following Schwartz's (1983) recommended procedures. The multiplier estimate, unadjusted for transfer payments, was 2.44. Details of the sectoring procedures are not provided here as they are reviewed in Schwartz (1983).

44. More detailed data is possible, but the analyst must be careful of suppression difficulties experienced with small counts in data cells. In addition, published data for Canada and the provinces is only available at the 3-digit level (Statistics Canada, Industry Trends, 1986), so to keep costs down it is advised to only pursue disaggregation to the 3-digit SIC level. If the order is placed with Statistics Canada, the analyst must specify that it is the 1971 definition of the labour force, as well as the 1971 definition of the SIC, that is required. This will allow comparison with the Statistics Canada publication Industry Trends.

Using the detailed industry data only produced a slight reduction in the employment multiplier for the South Peace region. This is not as significant as one might have expected given the money and time involved in obtaining the data. However, using this data does give the analyst more confidence in the results, and more familiarity with the local or regional economy. Whether the data is pursued will probably depend on how confident the analyst is with the results from the more aggregated, published data once it has been adjusted for transfer payments.

The fourth approach modifies the second and third by adjusting for transfer payments into the regional economy. Sectoring techniques tend to underestimate basic employment, and one of the primary sources of underestimation is excluding the effect of transfer payments on total regional employment. Gibson and Worden (1981) found that, of the adjustments they tried, transfer payments had the largest effect on the employment multiplier estimate.^[45]

Statistics Canada publishes income estimates for sub-provincial areas (Catalogue #13-216) which divide total regional income into several categories, three of which are relevant to estimating transfer payments. The first is government transfer, which includes UIC benefits, social assistance payments, income supplements, child care allowances, etc. The second category is investment income which includes dividends, interest payments, etc. The third is miscellaneous money income which includes pensions, superannuation, and other payments such as rent from boarders, scholarship income and alimony payments. Using this data may slightly overestimate transfer payments into a regional economy because of the components of the latter category, but it is a reasonable estimate of total transfers into a regional economy. If this transfer income estimate is pro-rated to reflect the size of the study region population, and then divided by the average employment income in the region, the number of basic jobs represented by these transfer payments can be estimated. These can then be added to the previous estimate of basic employment and the multiplier recalculated. For the South Peace region, total transfer payments in 1981 were estimated at \$44,597,746, and average employment income reported in the Census for the region was \$15,106. Thus the transfer income represented 2,952 additional basic jobs. Adding these to the number of basic jobs estimated using the published, highly aggregated industry data reduces the multiplier estimate to 1.61. Adding these transfer income-related jobs to the number of basic jobs estimated using the specially-ordered, more detailed industry data reduces the multiplier estimate to 1.54.

The fifth approach is to adopt a minimum requirements approach to estimating an employment multiplier. For a quick estimate, Moore's (1975) equation, derived from US data for a large range of city sizes and shown to be very accurate for estimating employment multipliers for small towns in rural Arizona (Mulligan and Gibson 1984), can be applied. Using his formula, which only requires a population estimate for the study region, suggests

45. Gibson and Worden (1981) also adjusted for part-time and seasonal employment, and out-commuting, but found these had a minor effect on the multiplier estimate compared to transfer payments. In their study region, part-time employment ranged between 15% and 20% of total employment. A 1979 survey of Chetwynd residents (BP Canada 1979) suggested that part-time employment ranged between 10% and 15% of total employment. If this is indicative of the South Peace economy, the Gibson and Worden results suggest it will not be a major factor in the employment multiplier calculations.

the employment multiplier in the South Peace is 1.67. Moore's formula is: $\Delta E = -20,36538 + 13.78340 \log(\text{population})$.

Isserman (1977) suggests the minimum requirements technique may provide a reasonable lower bound estimate for the employment multiplier; in this case it was very similar to the employment multiplier estimated using a combination of judgement and location quotients, and adjusted for transfer payments. This suggests the Moore equation may provide an estimate that is still slightly high, given the tendency for location quotients to underestimate basic sector employment.

TABLE A2
EMPLOYMENT MULTIPLIER ESTIMATES
SOUTH PEACE REGION, 1981

	Technique	Estimate
1)	Pick one from published estimates	1.50
2)	Assumptions + L.Q. (Division-level SIC)	2.66
3)	Assumptions + L.Q. (3 digit SIC)	2.44
4)	Assumptions + L.Q. + Transfers (3 digit SIC)	1.54
5)	Minimum Requirements (Moore equation)	1.67

Based on 1986 data and using method number 4 in Table A2, the employment multiplier for the South Peace was 1.43.

Constructing Income Multipliers Using Income Expenditure Analysis

Like employment multipliers, income multipliers can be constructed in numerous ways. The variations generally introduce more complex accounting formulations for leakages from the regional economy which, while they may be useful for very large regional economies (say the size of a metropolitan area), are likely unnecessary for small, simple regional economies. The more complex variations are also more data hungry and stretch the capabilities of the analyst and the data sources. A few good estimates of regional leakages are probably better than many fair estimates, and consequently it is recommended that the formulation of income multipliers should be kept relatively simple.

This section will examine three approaches to estimating an income multiplier to use in regional economic impact analysis. Attention will be given to how an income multiplier is constructed conceptually, and considerable detail will be given on alternative approaches to estimating regional income leakages, particularly the data sources that are available and the procedures that can be followed. This level of detail is presented because of the lack of a 'hands on' guide to estimating income multipliers. The lack of information on data sources and estimation procedures probably creates some aversion to using income multipliers in practice, despite their theoretical strengths.

The first approach to estimating a regional income multiplier is identical to estimating an employment multiplier: choose one from published estimates. The choice should be based on similarities between the region for which the published estimate was constructed and the study region. Table 2 in the report presented a selection of published estimates available prior to 1981; Table A3 updates this selection to 1986.

TABLE A3
INCOME MULTIPLIER ESTIMATES

Source	Project/Location	Multiplier
Ashcroft & Swales 1984	two counties in UK:	
	South Glamorgan, Wales	1.46
	Pop.(1971)=390,269	
	Cleveland, North Region	1.52
	Pop.(1971)=567,766	
	relocation of 4,020	
	and 3,000 civil service	
	jobs, respectively	
Davis 1986	seven BC regions:	
	North	1.25
	(Empl.=124,180)	
	Cariboo	1.19
	(Empl.=28,995)	
	Vancouver Island	1.37
	(Empl.=239,385)	
	Lower Mainland	1.49
	(Empl.=752,295)	
	Kamloops	1.22
	(Empl.=58,455)	
	Okanagan	1.27
	(Empl.=104,770)	
	Kootenay	1.23
	(Empl.=68,150)	

Given the selection of published estimates, an income multiplier of 1.15 - 1.20 for the study region is suggested, with the lower estimate probably being a more reasonable one.

The second approach to estimating an income multiplier is to conceptually construct one and estimate its components from published data. There are three steps that must be taken when constructing an income multiplier. First, the general equation that describes the components of regional income is set down.

$$Y = C + I + G + E - M \quad (11)$$

Then, the assumptions regarding the flows of income in the regional economy are expressed in terms of the components in equation (1). Over the short term, it is usual practice to assume that I, G, and E remain constant at I_0 , G_0 , and E_0 , respectively.

$$I = I_0 \quad (12)$$

$$G = G_0 \quad (13)$$

$$E = E_0 \quad (14)$$

C, consumption, is defined as a linear function of disposable income,

$$Y_d = Y - t_d Y \quad (15)$$

$$C = c_0 + c_1 Y_d \quad (16)$$

and M, imports, is also defined as a linear function of disposable income,

$$M = m_0 + m_1 Y_d \quad (17)$$

The third step is to substitute the equations (12) through (17) into equation (11), gather all the Y terms to one side and simplify. The income multiplier is:

$$K_y = 1 / (1 - ((1 - t_d)(c_1 - m_1))) \quad (18)$$

In this equation 'c₁' is the propensity to consume, 'm₁' is the weighted average of regional consumers' and businesses' propensities to import goods and services, and 't_d' is the direct tax rate. Of these components, 'm₁' is the most difficult to estimate, and so it will be dealt with last in the following discussion.

In the case of the NECP, average rather than marginal propensities will be used to estimate the multiplier components because it was expected that most of the new jobs would be taken by in-migrants, and it is appropriate to apply average propensities to their proportion of the income injection.[46]

To estimate the average rate of direct taxation, there are four potential sources of information. These sources vary in their definition of income and so the analyst must be careful to choose one that is consistent with data sources employed to estimate the other coefficients of the income multiplier.

46. However, application of average propensities to the portion of the income injection that accrues to regional residents may result in a slight overestimate of the regional impact, because marginal rates are more appropriately applied to increases in income received by regional residents. See previous footnote number 12 for further discussion of this point.

TABLE A4
SOURCES AND ESTIMATES OF AVERAGE TAXATION RATES, 1980

Source	Estimate
<u>Taxation Statistics,</u> Department of National Revenue for Peace River-Liard Regional District	17.11%
<u>Family Expenditure Survey,</u> Statistics Canada (62-555) for BC (1978 data)	17.63%
<u>Income Estimates for Sub-Provincial Areas,</u> Statistics Canada (13-216) for Peace River-Liard Regional District	15.11%
<u>Provincial Economic Accounts,</u> Statistics Canada (13-213) for BC	16.97%

Taxation Statistics provides total taxes paid and total income for individuals filing income tax returns. These data are available for small geographic areas. The data are based on a stratified sample of all the personal tax returns filed for the year in question, which includes all individual returns plus those of unincorporated businesses. The income concept is defined to include capital gains, but excludes most government transfer payments. It is not directly comparable to the definitions of income in the other sources listed here. Taxes paid only include income taxes and do not include UIC or CPP contributions. For the Peace River-Liard Regional District, the average rate of taxation in 1980 was 17.11%.

The Family Expenditure Survey, conducted by Statistics Canada every other year, records the average family income before taxes and total taxes paid for the year. The data are available at the provincial and national level and are based on a sample survey of families; in B.C. in 1978 approximately 10% of families were surveyed. The income definition includes government transfer payments but excludes capital gains, while the tax definition excludes UIC and CPP contributions. The average rate of taxation in B.C. based on this source was 17.63%.

The Statistics Canada publication, Income Estimates for Sub-Provincial Areas, records total money income received in the region and total income taxes paid. The figures are derived from the National Income and Expenditure Accounts. Money income includes government transfers but excludes capital gains. Taxes paid are strictly personal income taxes. In 1980, the estimated rate of direct taxation for the Peace River-Liard Regional District was 15.11%.

The Provincial Economic Accounts are also derived from the National Income and Expenditure Accounts, but they have a broader definition of income than the money income categories in the Sub-Provincial Income Estimates. In the National Income and Expenditure Accounts, personal income includes income-in-kind, supplementary labour income and imputed rents from owner-occupied dwellings. The tax concept is also broader and includes contributions to UIC and CPP as well as income taxes. For B.C. in 1980, the average rate of direct taxation was 16.97%.

The second component to be estimated is ' c_1 ' which is equal to $(1 - \text{the propensity to save})$. The propensity to save is a function of disposable income. Estimates of average rates of savings as a proportion of disposable income can be obtained from three sources, the Family Expenditure Survey, the Provincial Economic Accounts, and the National Economic Accounts.

TABLE A5
SOURCES AND ESTIMATES OF AVERAGE SAVINGS RATES, 1980

Source	Estimate
<u>Family Expenditure Survey</u> , Statistics Canada (62-555) for BC (1978 data)	4.98%
<u>Provincial Economic Accounts</u> , Statistics Canada (13-213) for BC (1980 data)	12.2%
<u>National Economic Accounts</u> , Statistics Canada, for Canada average during the early 1970s	7.7%

The discrepancy between these estimates may be accounted for by the variation in how savings are defined and calculated, and/or the timing of the estimates. In the Family Expenditure Survey there is a category of expenditures called 'security' which may be taken as an estimate of savings. However, it excludes net changes in assets which includes bank accounts, stocks and bonds, mortgage principal payments, and other forms of savings that are included in the Provincial and National Economic Accounts' definition of savings. The detail provided in the Survey is insufficient to include these other forms of saving with the security expenditure, and so it is recommended that the Survey estimate be used as a lower bound estimate of saving.

The 1980 estimate of saving in the Provincial Economic Accounts is very high and the analyst could reasonably have questioned how long such a high rate could be sustained, given historical savings rates in Canada and BC of approximately 6% (Economic Council of Canada

1979). A review of various analyses of the change in savings rate in Canada that were available in 1980[47] suggested that the high savings rate at that time was stimulated by inflation and institutional arrangements that encouraged savings. Thus it would have been reasonable to use three estimates, a high a low and a 'best', rather than choose only one. The high savings would be taken from the Provincial Economic Accounts, the low rate from the Family Expenditure Survey, and the 'best' rate would be the rate of savings in the National Economic Accounts for the early 1970s.

The final, and most difficult, component to be estimated is ' m_1 ', the propensity of regional consumers' and businesses' to import goods and services. One way to estimate ' m_1 ' produces a value that is the weighted average of the two import components (consumer imports and business imports). First, the expenditure pattern of individuals or households is estimated. Then the number of dollars spent by consumers in various expenditure categories when outside the region is estimated. The next step is to remove these 'leaked' dollars from the assumed total expenditure pattern; this yields regional consumption by expenditure category. Then, estimates of business import propensities are applied to the dollars of regional consumption in each expenditure category. The estimated total number of dollars leaked out of the region through business imports is then added to the estimated total number of dollars spent outside the region by consumers, and this total is divided by average disposable income. The result is an estimate of ' m_1 ' that is a weighted average of consumer and business imports.

The procedure seems simple, but empirical estimates are difficult to produce and so they will be given substantial attention below.

Estimates of consumer expenditures are available at the provincial level from the Family Expenditure Survey, and it is reasonable to assume that regional expenditure patterns closely resemble provincial patterns. Estimates of consumer imports are very difficult to produce. There are few published estimates available,[48] and so the analyst's judgement must be employed. Important factors to be considered are whether the study region encompasses the primary trade area, the level of development of the regional service sector, work or shift patterns that promote or discourage travel outside the region, the competitiveness of nearby

47. One analysis was put forward in Two Cheers for the Eighties (Economic Council of Canada 1979). The change in personal savings rate as a proportion of disposable income was dramatic, occurring in a very short period in the mid-1970s. During the 1960s the savings rate averaged 5.3% in Canada, rose to 7.7% in the early 1970s and was 10.4% by the late 1970s. The rise in savings was partially attributed to high inflation rates and the increase in home ownership (and the concurrent high savings rates to accumulate down payments), and to institutional arrangements, such as RRSPs and RHSPs, that favoured high savings rates. The ECC suggested it would not be surprising if the Canadian savings rate declined in the future because of the vast amounts of highly liquid spending power that had been accumulated in the 1970s. A report published the following year, (ECC 1980), reinforced these suggestions, forecasting a decline in the savings rate from 10.1% in 1980 to 7.6% in 1990. Finally, the federal Department of Finance, in its 1980 Economic Review, echoed the analysis of the ECC and suggested the higher savings rate would not be sustained indefinitely.

48. Yannopoulos (1973) estimated that 8.2% of disposable income in Reading and 10.9% of disposable income in Hemel Hempstead, two provincial centres in the UK, went to non-local consumption. Both of these communities are within an hour's travel of London, with Hemel Hempstead being closer. Hemel Hempstead is also a smaller community than Reading with a less well-developed business sector.

centres, and the isolation of the region. The estimates of consumer imports utilized for the income multiplier for the South Peace study area in 1980 are provided in Table A6.

Indirect estimates of regional value-added in various sectors were available from two sources in 1980. First, estimates published in other income multiplier studies could have been used (Table A7). These authors have used either gross retail margins or payroll-to-sales ratios to estimate regional value-added, on the assumption that in most regional economies, most of the goods sold regionally have been imported and so the regional value-added comes only from the wholesaling and retailing of these goods. Gross retail margins probably slightly overestimate regional value-added because some of the occupancy and sales and administration expenses will leak out of the regional economy, but payroll-to-sales ratios probably underestimate regional value-added because these assume that only wages paid remain in the regional economy. For the size of the economies under consideration by the various authors, refer to Table A3 above and Table 2 in the main document.

TABLE A6
ESTIMATES OF CONSUMER IMPORTS
SOUTH PEACE REGION, 1980

Expenditure Category	Total Expenditure	Non-Local Expenditure
Food		
at home	2530.9	253.0
in restaurants on trips	155.9	379.2
purchased on trips	26.3	26.3
Shelter		
while away	135.9	135.9
vacation homes	28.1	28.1
Household Op.		
HH supplies	283.5	28.35
Household Furn.	926.7	86.1
Clothing	1089.4	217.88
Personal Care	272.6	27.26
Tobacco/Alcohol	557.1	83.57
Transportation		
auto purchases	1062.0	106.2
auto operation	1171.9	117.2
rented vehicles	20.6	20.6
Recreation		
tickets for events	74.3	37.2
home recr. equip.	180.2	36.0
outdoor recr. equip.	521.6	192.0
home entertainment equip.	246.1	116.4
holiday expenses	45.3	45.3
reading materials	100.5	49.0
TOTAL	n/a*	1768.8

* Not all expenditure categories have been included in this table, only the ones considered to have significant possibilities of consumer imports, thus the total in this column is not relevant information. In this table, total expenditures by categories are from the Family Expenditure Survey of 1978 for BC, published by Statistics Canada.

Once the consumer imports have been estimated, they must be subtracted from total expenditures, by category. Then the import propensity of regional businesses in each category of expenditure must be estimated and applied to the regional expenditures.

Like estimating the value of consumer imports, it is also difficult to estimate the propensity of businesses to import in various expenditure categories. One option is to conduct a survey of regional businesses but this is expensive and time-consuming. The other option is to use indirect estimates of regional value-added by businesses in various sectors of the economy. When expressed as a proportion of total sales, the propensity to import is equal to (1 - the propensity to add value regionally) in each of these sectors.

TABLE A7
PUBLISHED ESTIMATES OF REGIONAL VALUE-ADDED

Expenditure Category	Archibald 1967 ^a	Greig 1971 ^b	Yannopoulos 1973 ^c	Wilson 1977 ^d
Housing	1.00(rent) 0.75(repair)	0.18	1.00	0.219
Utilities	0.14(elect.) 0.21(gas)	0.19	NA	0.397
Eating & Drinking Places	0.27	0.41	0.20	0.257
Food Stores	0.60			0.083
General Merch. Stores	0.60	0.31	0.30	0.134
Apparel Stores	0.60	0.33	0.50	0.149
Other Retail Stores	0.60	0.27	NA	0.124
Lodging	0.80	NA	NA	0.285
Personal & Business Services	0.58	0.37	0.58	0.349
Automotive Serv.	0.14			0.125
Automotive Dealer	NA	0.22	0.20	0.092
Amusement & Recreation	.16(cinema) .27(other)	0.37		0.293
Drink & Tobacco	NA		0.22	NA
Local Gov't.	0.50	0.09		0.397
Charities	0.80	NA	NA	0.105
Services from local households	0.87	NA	NA	1.00
Payments to financial intermediaries	NA	NA	NA	0.20
Miscellaneous	0.80	0.20	NA	NA

^a Expenditure categories divided into three classes; those where regional value-added was likely to be equal to direct labour costs only, those where value-added would be closer to the gross retail margin, and those where guessimates had to be made.

^b For retail groups gross retail margins were used, for intermediary non-retail (utilities) Archibald's estimates were used, for others (local services and food) guessimates were employed.

^c Combination of average retail margins and Archibald's estimates.

^d Payroll-to-sales ratios for retail and service industries, other estimates derived locally or from previous work by author.

In 1980 the second source for obtaining estimates of regional value-added was the national input-output table for 1979. Gross retail margins for durable, semi-durable and non-durable goods industries can be obtained from the table and they are presented in Table A8. Because these data are national data, their applicability to small regional economies is somewhat limited. However, they do provide a check against the published estimates and at least a 'ball park' figure for some of the expenditure categories. Unfortunately many of the expenditure categories in the Family Expenditure Survey are not dealt with, and so the published estimates must be used in these cases or guestimates made.

TABLE A8
ESTIMATES OF NATIONAL RETAIL MARGINS, 1979

Expenditure Category	Retail Margin
Autos, repairs and parts	.1445
Other durables	.2164
Clothing and footwear	.3499
Other semi-durables	.2254
Food, beverages and tobacco	.1642
Fuel and electricity	.0050
Gas, oil and grease	.1034
Other non-durables	.2676

The final source of information for estimates of regional value-added is one that has only recently become available. In 1984, Statistics Canada began publishing Small Business Profiles for the provinces. These profiles provide information on operating expenditures (by various categories) as a proportion of total sales for numerous industries. While initial coverage was limited to a small number of industries, by 1986 approximately sixty industries were covered by this publication. It can be used to estimate personnel costs as a percentage of total sales which would represent a high estimate of import propensity, or gross retail margins (total sales - cost of goods sold) which would be a low estimate of import propensity.

Once the total dollars 'leaked out' of the regional economy via business imports is estimated, it can be added to the total dollars 'leaked out' via consumer imports, and then divided by total disposable income to yield a weighted average estimate of ' m_1 '.

Table A9 summarizes the estimates of the income multiplier parameters and the resulting income multipliers produced using this second approach to estimating an income multiplier.

TABLE A9
ESTIMATES OF INCOME MULTIPLIER PARAMETERS
FOR SOUTH PEACE REGION BC, 1980

Multiplier Component	Low	Estimate High	'Best'
' t_d '	.183	.151	.151
' c_1 '	.878	.954	.923
' m_1 '	.731	.619	.675
K_y	1.136	1.397	1.267

The multiplier range is very wide, emphasizing how important the analyst's judgement is when making the final choice of values for the various multiplier components. However, the 'best' estimate is in the range of those selected using the first approach, choosing one from published estimates.

The third approach to estimating an income multiplier examined in this research is a modification of the second; it splits the import coefficient into two parts, rather than producing a weighted average.

$$M = M_c + M_b \quad (19)$$

$$M_c = m_c C \quad (20)$$

$$M_b = m_b (C - m_c C) \quad (21)$$

where

M_c is consumer imports

M_b is business imports

C is total consumption

Substituting these equations into equation (11) yields the multiplier formulation,

$$K_y = 1 / (1 - (c_1(1 - t_d)(1 - m_c - m_b + m_b m_c))) \quad (22)$$

The propensity of consumers to import is obtained by dividing the value of consumer imports by the **total value of current consumption**. The value of consumer imports are estimated in the same way as with the previous approach to estimating ' m_1 '.

The propensity of businesses to import is obtained by dividing the total dollars 'leaked out' of the region by **total local consumption**. Total dollars 'leaked out' of the region via business imports is calculated the same way as in the previous approach. Table A10 presents the estimates for income multiplier parameters and the multipliers using this third approach to estimating an income multiplier.

TABLE A10
ESTIMATES OF INCOME MULTIPLIER PARAMETERS
FOR SOUTH PEACE REGION BC, 1980

Multiplier Component	Estimate		'Best'
	Low	High	
' t_4 '	.183	.151	.151
' c_1 '	.878	.923	.923
' m_c '	.119	.119	.119
' m_b '	.798	.655	.727
K_y	1.146	1.327	1.232

The multipliers in Table A10 are very close to those in Table A3 above and Table 2 in the main text. Separation of the ' m_1 ' components in the multiplier formulation is preferred; the assumptions employed to arrive at the final estimates have greater visibility.

There are many other forms of leakages that could be included in the income multiplier. However, more detail makes the data requirements increase. For most small regional economies, the level of data available will not support more detailed multiplier formulations.

All of the income multiplier estimates presented so far have ignored the business sector of the regional economy. Corporate direct taxes are not included, and regional value-added by manufacturing businesses is ignored. This may not be reasonable if the regional economy under consideration has a manufacturing sector that is providing goods for local consumption. In this case, assuming that regional value-added is strictly associated with wholesaling and retailing will overestimate the value of ' m '. The difficulty is that data on regional value-added in manufacturing sectors are not usually available at the regional level (one would need an input-output table), and consequently it would be very expensive to include this. Davis (1986) has presented a potential solution to this problem. Using an I-O Table for the Lower Mainland, Davis estimated the direct and indirect regional value-added per dollar of local consumption across 18 different producing sectors. These Lower Mainland figures were then adjusted for the size of the regional economy to produce estimates of direct and indirect regional value-added per dollar of local consumption for the other regional economies in BC (assuming employment levels are a reasonable indicator of economic development of the manufacturing sector). For larger centres where manufacturing is an important component of the economic base, Davis's approach is recommended.